

Aviation Week & Space Technology

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November 11, 1963

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Traffic Control
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Lear Jet Executive Aircraft



Aircraft Probe Missile Tracking Noise Cause

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To get the most out of analog data, you should be able to see it, now or not later, use it now or use it later.

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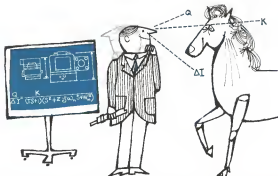
At the same time, you can record tape to eight channels (plus voice and synchronization) of data up to 10,000 cycles on the 5000 particles. Later on, you can play selected portions of your data into the Visconder. Four tape speeds (15, 30, 45, and 90) give you records and playback flexibility for whatever frequency you're recording.

In the Honeywell 8100, several lead and tape recording tapes are available (including HILC). All models have a built-in calibration signal, automatic switching of order frequencies, and a new improved tape drive that rotates faster on a magnetic disk in the tape housing. A built-in master tape and voice channel is optional. In addition, Honeywell Visconder can give laboratory tape extra trace with capacities of up to 50 channels on 2 inch tape.

For complete information about the Honeywell 8100, the Visconder Oscilloscope, and other recording equipment, contact your nearest Honeywell office, or write Honeywell, Device Division, Room 10, Oak Grove Road, at 303 594-1211. In Canada, contact Honeywell Canada, Ltd., Toronto 17, Ontario.

DATA HANDLING SYSTEMS

Honeywell



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Let us help you make a trade-off study that is bound to provide you with the exact combination of performance characteristics you need... and at a cost that fits your program requirements. While you're at it, write for Servovalve Bulletin A-5231 and for Vickers Servovalve Types and Definitions Handbook. Write to Vickers Incorporated, P.O. Box 301, Troy, Michigan.



Two basic Vickers servovalve designs include the miniature 30 series servovalve (left) and the compact 10 series jet-pipe valve (right).

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D-2000

Through a Glass, Clearly

Looking at a display is rather like holding up a transparent glass to get a small bit of information from among a vast landscape of data. When the computer has related the data entered to the monitor, the display must then bring it up to the human eye with utmost clarity of meaning. And as a mass of programmed information increases, more and more flexibility will be demanded of both the system and the display. Then every important "feedback" question about displayed information must be asked and answered. Where, for example, is that fine line between too little information and too much? How can rapidly changing data best be exhibited so that eyes and hands quickly get the message? When should facts and figures be shown in an arbitrary manner, when is more dramatic fashion? How can displays anticipate the answering of unasked questions? Much of the work of SDC scientists and engineers is and has been linked together by the

common denominator of display, which in turn are the most sophisticated link between man and machine—between computer and decision maker. The broad experience base being built by SDC men and women is, in turn, helping to shape the information systems of the future. If you are interested in shaping your own future in the science of systems, SDC offers opportunities of several unique and challenging. Human factors scientists, operations research scientists, systems-control engineers, and computer programmers are invited to write Mr. A. K. Givens, Jr., SDC, 3442 Colorado Ave., Santa Monica, California. Positions are open at SDC facilities in Santa Monica, Washington, D.C.; Lexington, Massachusetts; Falmouth, New Jersey; and Dayton, Ohio. "An equal opportunity employer."

System Development Corporation



AEROSPACE CALENDAR

(Continued from page 5)

- Radio Technical Conference for Astronauts**, Washington, D.C.
- Dec. 4-6**—Testing of Manual Flight Systems Conference, American Institute of Aeronautics and Astronautics/NF Flight Test Center/NASA Flight Research Center, Edwards AFB, Calif.
- Dec. 4-6**—Thermal Engineering Symposium, Institute of Electrical and Electronic Engineers, Marriott Water Hotel, Washington, D.C.
- Dec. 14-16**—Natl. Conf. on VHF/UHF Communications, Institute of Electrical and Electronic Engineers, Arlington Hotel, Dallas, Tex.
- Dec. 4**—Fourth Annual Seminar on the Reliability of Space Vehicles, Institute of Electrical and Electronic Engineers, Airport, Monaco Hotel, Los Angeles.
- Dec. 11-13**—Conference on Heliospheric Conditions, American Institute of Aeronautics and Astronautics, Palm Beach, Fla.
- Dec. 13-14**—National Visions Meeting, Space and Flight Engineering Association, Diego Aerospace Museum, San Diego, Calif.
- Dec. 16-17**—Conference on NonLinear Phenomena in the Ionosphere, National Bureau of Standards Boulder Laboratories, Boulder, Colo.
- Dec. 18**—Sixth Annual Army Aviation Conference, Southwest Symposium, Maryland Hotel, Washington, D.C. Sponsor: National Aerospace Services Assn.
- Dec. 18**—Annual Meeting, American Assn. for the Advancement of Science, Cleveland, Ohio.
- Jan. 7-8**—Tenth National Symposium on Reliability and Quality Control, Sheraton Hilton Hotel, Washington, D.C.
- Jan. 13-15**—Society of Automotive Engineers Automotive Engineering Congress & Exposition, Dallas Hall, Detroit, Mich.
- Jan. 19-21**—1963 Annual Convention, Helicopters Assn. of America, San Marcos Inn, Chula Vista, Calif.
- Jan. 28-29**—Annual Winter Meeting, American Institute of Aeronautics and Astronautics, Grand Astor New York, N.Y.
- Jan. 30**—Sixteenth Annual Island Region Quality Control Conference, American Society for Quality Control, California State Polytechnic College, Pomona, Calif.
- Jan. 29-March 20**—Aerospace Technical Conferences, Society of Physics Engineers, Cleveland, Ohio. Locations: Hall Hatch, Atlantic City, N.J.
- Jan. 29-30**—Applications Forum on Automatic Research, University of Illinois, Materials Research Research Center, Urbana, Ill.
- Jan. 29-31**—1963 Annual Meeting, American Meteorological Society, University of California, Los Angeles, Calif.
- Jan. 29-31**—Solid Propellant Rocket Conference, American Institute of Aeronautics and Astronautics, Palm Jai, Calif.
- Jan. 30-31**—Annual Computer Applications Symposium, IRT Research Institute, La Salle Hall, Chicago, Ill.
- Feb. 3-7**—Fifth Annual Lectures in Aerospace Medicine, USAF School of Aerospace Medicine, Brooks AFB, Tex.
- Feb. 14-15**—Fifth Winter Convention on Military Electronics, Institute of Electrical

(Continued on page 9)



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F&M Systems Company is responsible for detail design, fabrication, installation, and checkout of a highly advanced data acquisition and instrumentation system for the OTAN 100 Inlet Water Test Facility at Edwards Air Force Base, California. The Air Force facility will be operated by United Technology Center for testing UFG's afterburned thrust, and powered engine test of which will make up the first stage of the OTAN 100.

HOW TO INTERROGATE A MILLION-POUND THRUST

At Edwards Air Force Base, for example, F&M Systems has furnished a data acquisition and instrumentation system providing 564 information channels and 121 channels of control. Strain gauges, thermocouples, and other transducers gather information on stress, pressure, temperature, vibration, etc. F&M instrumentation calibrates and conditions this information for data recording. Video and audio site communications, safety controls, "quicklook" oscillographic data displays, and go-no-go indicators are also included. This F&M Systems' project required over a quarter-million terminations.



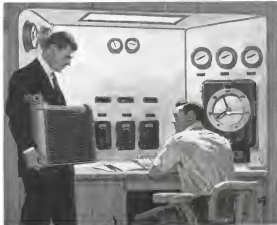
F&M Systems Co. is a division of Fluckhach and Moore, Incorporated, one of the largest electrical contracting firms in the world. F&M Systems accepts total responsibility—from design through on-site checkout—for instrumentation of electronic, electro-mechanical, hydraulic, pneumatic, and nuclear systems.



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34 AIR FORCE MEMBERS WILL HAVE THE SAME NAME/RANK/NUMBER:
(NAME) BURROUGHS, (RANK) MODULAR COMPUTER, (NUMBER) D825



The heart of the Back Up Interceptor Control System (BUICS) is the Burroughs D825 Modular Data Processor Thirty-four (34) D825's will serve in the capacity, gaining the following advantages for BUICS:

1. **Modularity**—All modules of the D825 are functionally independent, yet completely inter connected, allowing simultaneous operation of multiple computers, memories, and I/O control elements within one system. This means that the system configuration can be tailored to the application from truly "off-the-shelf" data

processing modules without having to pay for excess capacity. At the same time, if more, the system can be easily expanded by the addition of modules, should changing requirements so dictate.

2. **Real Time Response**—The comprehensive intercept system of the D825 permits rapid response to real time inputs without flexibility, involving a real time clock, ray programming of real time outputs. Through testing, the D825 has proved its ability to function with accurate accuracy from power failure without loss of information.

3. **Programming**—Multi, efficient instructions of variable lengths, comprehensive indexing and indirect addressing facilities, and arbitrarily locatable programs provide high storage efficiency and simplified storage allocation.

Of course, even the D825's total modularity couldn't provide these advantages if it weren't for the capabilities of the machine themselves. The Computer Module is a D825, for instance, has a 16K file "switch pad" memory. The D825 will accommodate up to four such computer modules. Both computer and I/O

modules have direct access to all (up to 16) ferrite core memory modules. In addition, machine features allow a D825 resident program to control multi-programming and parallel processing in managing system modules for unified system behavior in various applications.

We would welcome an opportunity to prove the system's greater throughput at other applications. Or write for our folder, *Burroughs Modulates D825 Modular Data Processing System*, Defense and Space Group, Burroughs Corporation, Poughkeepsie, New York.

Circle 10 on Reader Service



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This may well be

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and delivered*

in less than 5 months

These Canadians can sometimes do the darnedest things. Take this wing actuator system for Lockheed's mighty C-141 military/commercial jet air freighter due to make its first flight this year.

The manifold block has 41 different plug-in valves and pistons and over 200 cross-porting holes, making it look like a bright and shiny Swiss cheese. These many different components control a complex list of functions plus some unique safety features introduced into the system.

When Jerry Hydraulic Limited, Montreal was awarded the contract they knew they had a "pay-up-or-shoot" undertaking, because both engineering and time demands were crucial. Using their own 3 plants and a variety of subcontractors they moved on a record-the-clock

basis, pioneering every step of the way. They didn't have time for floggings as they manifolded all components from rough cut steel and aluminum blocks. Tool design and manufacturers were pre-organized as they ran, so that tools were available at the precise moment required. Exact duplicates of the manifold block were manifolded first to prove the tools prior to machining the aluminum. Prep-and-a-half months after conception Jerry officials triumphantly flew the first system to Lockheed's Georgia plant.

Yes, this Canadian team of hydraulic engineers and manufacturers has been coming up with breakthroughs like this for some time now. Next time you have a hydraulic requirement get Jerry's thinking. A member of the world's most successful aircraft already incorporate it.



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The fast-acting computer allows our engineers to tackle more advanced filter designs, and gives them time to approach a problem in many different ways to pick up the extra in refinements and performance. Designing filters by computer is another of the progressive techniques we use to provide you with telecommunications systems of the highest quality and reliability. Lenkurt Electric Co., Inc., San Carlos, Calif.

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EDITOR: ROBERT E. HARRIS
ASSISTANT EDITOR: J. L. O'NEILL, JR.
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Aviation Week
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November 11, 1963

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COVER: No. 1 test jet airplane prototype aircraft, powered by two General Electric C-125 engines, is shown in low altitude pattern over the Atlantic. The aircraft, which made its first flight last month (ENR Oct. 14, p. 31), has been remodeled about 7 in. flight time to date. The test jet entered a calibrated turn of about 400 mph. (Photo: NASA) as it took flight from the New York, New York, area.

COVER: General Electric C-125 engine, shown in low altitude pattern over the Atlantic. The aircraft, which made its first flight last month (ENR Oct. 14, p. 31), has been remodeled about 7 in. flight time to date. The test jet entered a calibrated turn of about 400 mph. (Photo: NASA) as it took flight from the New York, New York, area.

November 11, 1963

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Similar testing proved its worth in the Project Mercury space test program, resulting in better, more reliable materials.

The new simulator will be used to evaluate a wide range of physical, thermal and electrical properties of different materials in a space environment. It will help develop better products for space flight. For complete information on use of this facility, write B.F. Goodrich Aerospace and Defense Products, a division of The B.F. Goodrich Company, Dept. AW-11, Akron, Ohio.

EDITORIAL

New Light on SST Problems

Some much-needed light has been shed on the financial, technical and managerial problems of developing the proposed U.S. supersonic transport during the recent hearings conducted by the Senate subcommittee headed by Sen. A. S. Mike Mansfield (AW Oct 21, p. 38, Oct 28, p. 37, Nov. 4, p. 40).

A detached group of men who eventually will be responsible for the design, construction and operation of supersonic transport was provided a badly needed opportunity to present their views to Congress and the American public. It is so inspiring that these views differed widely from the erroneous preconceived notions of the Federal Aviation Agency officials promoting the program under their agency's aegis.

We think that the FAA has done an excellent job in sparking top-level U.S. government interest in the supersonic transport program, and it has certainly been the principal catalyst in bringing the executive and legislative branches of the government together with the aircraft manufacturers and airline operators to consider a future course of action. The hearings indicated solid unanimity on the idea that the U.S. must embark on a supersonic transport development program as a major national goal, but there was considerable divergence in just how this goal can be reached.

One of the most significant points developed by the hearings is that the FAA has vastly underestimated the development costs of the supersonic transport, and that the aircraft manufacturing industry cannot and will not absorb even the burden of these costs that the government has agreed to fit.

Military Experience Missing

A principal factor contributing to these high costs is the lack of the usual foundation of military experience that has bolstered U.S. transport development through the subsonic jet age. The only military aircraft currently contemplated in the Mach 2.5 to Mach 3 speed range of the supersonic transport is the North American B-70. It is dubious whether this program will ever accumulate sufficient flying time to be useful in super-sonic transport development, due to the present Pentagon policy of straggling at financially.

In any case, neither the subsonic nor the engine would be suitable for modifications into a subsonic cruise vehicle in the manner that the C-54 developed into the DC-6 or the C-119 and its J57 jet engines developed into the T-37 series. For the first time in more than a decade, commercial transport development is being given the responsibility for spearheading basic state-of-the-art advances into a new operational regime. The development costs for the new type of engine required for the supersonic transport are about equal in industry estimates to the FAA estimate for the whole development program. In contrast, the Anglo-French Concorde

program is utilizing a Bristol Siddeley engine that has been under development for some time for a military program, and it will accumulate considerable flying time before the Concorde prototype makes its initial flight.

It was also evident in the hearings that the industry has little confidence in the FAA's capability to manage a supersonic transport development program. Although FAA proposes to spend some \$1 million to assemble a managerial team in the project, it has no previous experience in this area and there are serious legal doubts as to whether it can assume responsibility for both development and certification of a new transport. FAA and its predecessor, CAA, had most of their development program experience in the electronic field, and their practices were such as to drive most of the larger and more experienced firms out of that market. The rather odd manner in which the FAA is currently attempting to conduct a Phase I design competition without indicating any firm design objectives has increased industry's questions about the venture.

Prototype Tests Necessary

With the lack of any adequate military technical foundation for the supersonic transport development, it is becoming increasingly obvious that an experimental prototype must be built and given considerable flight testing before it will be possible to finalize a production line design suitable for airline service. This process will add to the development expense. But it offers the only greater assurance that the end product will meet final useful applications in airline service.

The Air Force, which has had more aircraft development experience than any organization in the world, has tried both ways. After its recent experiences in trying to buy production designs from the drawing board, it is swinging sharply back to the development and testing of prototypes before commitment to a weapon system configuration and production. It would appear wise for the FAA to benefit from this experience.

There is another disturbing fact of the FAA activities in commercial transport development. In addition to its supersonic burden, it is now attempting to finance design studies at the other end of the spectrum for a slow, short haul freighter, to the tune of \$300,000. This is certainly an area that needs no government interference, since manufacturers are usually willing and able to develop this type of aircraft with their own resources. In fact there is a wide variety of such aircraft already flying in prototype form from which the local service airlines can and will make a choice if unimpeded by federal interference. It appears that the FAA has ambitions to become a British-type Ministry of Supply operation, and that, of course, would spell certain disaster for the future of U.S. air transport.

—Robert Helt



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WHO'S WHERE

In the Front Office

Stanley Associates, Inc., New York, N. Y., has placed the following executives in direction, increasing the helicopter operations from eight to 12. **Bob L. McLaughlin**, manager of contracts, **George J. Shoup**, manager of manufacturing, **David E. St. James**, manager, Computer Resources Div., **Norman R. W. Mc**, corporate secretary.

Charles B. Thornhill, head chairman and chief executive officer of Litton Industries, Inc., elected a director of General Mills, Inc., Minneapolis, Minn.

Raymond H. Rasmussen, president of Los Angeles Div. of North American Aviation, Inc., elected a director of H. J. Thompson Filter Glass Co., Gardena, Calif.

Wesley C. Bacon, Jack D. Ryan and Donald H. Sheffield, directors, Hercules Powder Co., Wilmington, Del. Mr. Bacon is general manager, Polymer Dept., Mr. Ryan, general manager, Explosives and Chemical Products Dept., Mr. Sheffield, general manager, Synthetic Dept.

James M. McGowan, vice president program management, Lark Div., General Precision, Inc., Binghamton, N. Y., the executive in director of engineering.

Ar. Goudimov, F. R. Banks, director and chief member, Hawley Safety Associates, Inc., Hartford, Conn., **Richard**, Appointed director of the de Havilland Co., A. S. White (general manager), J. P. Smith (sales manager), R. M. Carlson (executive), A. G. T. Price (deputy chief engineer), J. Cunningham (chief test pilot), A. Small (production).

Donald C. Sullivan, vice president and director of new markets development, Carl and son, General Systems Div. of Litton Industries, Woodland Hills, Calif.

Robert (Toby) Hines, vice president program and design director, Ling-Tecnic-Vought, Inc., in Washington, D. C.

John K. Wertheimer, vice president-plan and engineering, Avco Corporation, Avco Corp., Middletown, Ohio.

Paul W. Price, vice president-properties, DeLoe Air Lines, Inc., and David G. Garret, Jr., assistant vice president operations.

Dr. Peter J. Larson, a top generalist, North Star Research and Development Co., Seattle, Washington, Minn.

Vice Adm. E. R. McLane, Jr. (USN, ret.), a vice president, Pacific Aircraft Corp., Philadelphia, Pa.

Honors and Elections

Flight Safety Foundation's 1961 Award for Outstanding Service, for assistance to aviation in the achievement of safe air operations of aircraft, have been presented to Capt. Carl M. Christensen, assistant vice president operations of United Air Lines.

John H. Swainson, chief, Aviation and Second Branch, Civil Aeronautics Research Institute, operated by the Federal Aviation Agency, and to "the dedicated personnel of the Census Bureau Flying Network Visual" air station at various points in the North Atlantic and Pacific.

The awards are sponsored by Aviation Week & Space Transportation.

(Continued on page 120)

INDUSTRY OBSERVER

Twenty-six of the 92 Gradyne QH-50C drone anti-submarine helicopter (DASH) delivered to the Navy so far have crashed, most of them at sea. Technical difficulties led to the unmanned helicopter being grounded earlier this year (AW July 6, p. 33), but it is now operational. Program calls for about 400 helicopters at a target unit of cost of \$125,000.

NASA's Manned Spacecraft Center is conducting industry proposals for concept development and model studies of Gemini/Apollo sea retrieval equipment. Apollo pickup weight would be 12,000 lb. with trapped water. Corresponding Gemini weight would be 5,000 lb.

Vanderbilt AFRL may be designated as an additional launch site for USAF Space Station Div's Titan 5 in order to achieve a polar orbit with a maximum period. This probably could not be achieved by structural maneuvering after launching from Cape Canaveral because of thrust and fuel limitations in the vehicle's terminal stage.

Potential payloads being analyzed by General Dynamics/Astronautics for USAF's Space Systems Div. include orbiting unmanned vehicles for reconnaissance and satellite intercept functions. Study is tied to use of the Titan 3C with a boost capability of about 23,000 lb. to orbit. Matra/Dever also is studying payload missions for Titan 3 beyond Dynochem.

Bell Helicopter Co., engineers concerned with the Sioux Scout remote tactical helicopter program (AW Sept. 13, p. 30) are assessing an evolved low-efficiency nonsupercooled canopy material. They consider that present canopy materials provide the most difficult problem in helicopter design because of low-velocity characteristics because of their tendency to produce glare which attracts attention to a helicopter from long distances.

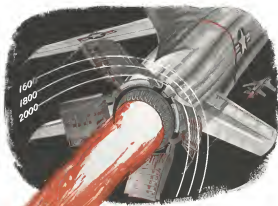
Industry proposals for detail design and construction of a generalized V-STOL transport fuselage wind-tunnel model are being evaluated by NASA's Ames Research Center. Model will be 44 ft. long and have a rectangular cross section 5.8 ft. wide with faired nose and tail sections.

Feasibility study and preliminary design of passive dampers for mounted, rotating space structures is being conducted by Space Technology Laboratories after an industry competition sponsored by NASA's Langley Research Center. STL's STL-300 damper study is concerned with a self-aligning configuration having a mass in order of 10,000 lb. and accommodating 21 cross members (AW Nov. 12, 1962, p. 32).

North American Aviation next month will receive proposals for development tests which may determine the schedule for installing the payload in the Gemini spacecraft. There was some discussion that the first 10 Gemini spacecraft would be purchased because of unusual payload storage and deployment problems.

Mission of 30% fluorine and 70% oxygen by weight has been tested in a 300-cc. gas generator firing with RP-1 fuel by North American's Rocketdyne Div. in a research program for NASA's Lewis Research Center. Mixture up to 70% fluorine probably will be evaluated. The oxidizer combination has been achieved by General Dynamics/Astronautics for substantial boost capability improvement for Atlas (AW July 15, p. 33).

Twin-engine Sikorsky CH-47 helicopter has been performing valuable service in South Vietnam in a flying crane in recovering downed aircraft. The need for such a machine has been proven in Vietnamese combat operations, where CH-47s usually steady when tactical aircraft are engaged, study to lift downed helicopters out of the combat zone. A considerable number of helicopter and landing aircraft have been recovered by the CH-47A in less than 10 min., flown back to base, repaired and put back into action the next day.



Braking 23 Tons at 1200 MPH

Free brakes are called upon to take such a beating. That's why HAYNES alloy No. R-41 was selected for a critical area of the post-type speed-brake on the Air Force's new F-35G Thunderchief fighter bomber. Close, the well-insulated "petals" enclose the flaring gas blast behind the J75 engine's afterburner. Then, tremendous stress loads and thermal shock are imposed as the wingtip speed-brake whip open into the cold airstream—so check the braking speed of the 33-ton, Mach 2 fighter.

Haynes high temperature alloys that resist temperatures of 2700 deg. F and over—for long periods and under great stress—today serve many hot spots. Resistance to stress, to thermal shock, to corrosion, erosion, and fatigue, are typical properties that make these alloys so extremely useful in turbopump casings, in nozzles, manifolds, nozzles, manifold space casings.

For more information on Haynes high-temperature alloys write: Union Carbide Corporation, Special Division, 220 Park Avenue, New York, N. Y. 10017.



Mechanic adjusts hinge of speed-brake door where critical joint area of Haynes alloy No. R-41

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Washington Roundup

SST Economics

Fortifying economic report from banker Eugene Black on the supersonic transport promises to outweigh all the recent testimony on technology and by the balance demands for a speedier development of the aircraft.

President Kennedy could even go so far as to use the report as a basis for withdrawing his support from the U. S. supersonic transport program, although this does not appear likely. But it is certain that the Black report will be regarded as the only realistic look at supersonic transport development costs.

Eight now, on one really known fact, it will cost to develop the aircraft. FAA's estimate of \$3 billion is little more than an estimate which was started to fit another use. This week's Chairman Mike Mansfield of the Senate aviation subcommittee as he looks ahead to his job of selling the supersonic transport to the Senate floor.

He feels the Senate will accept the heavy cost estimates this year and go along with the SSI studies, even general studies approved by the House. But support next year, when the real costs are known, is doubtful—especially if Black denies the program is a bad risk. Black was a negotiator as a realist while president of the World Bank.

Although aviation companies insist they cannot afford to contribute 25% of the supersonic transport's development cost, Sen. Mansfield feels Congress will not accept the inflated price. The real problem of getting the U. S. supersonic transport off the ground is Sen. Mansfield's view—a more use of money than of technology.

AMP Study Contracts

General Dynamics/Ft. Worth, Boeing and North American have been chosen by the Air Force to study the feasibility of the Advanced Mixed Propulsion Aircraft (AMP), formerly low altitude mixed propulsion (LAMP). All three companies proposed using kerosene-type fuels for the engine while Douglas proposed liquid hydrogen. Proposals were submitted Oct. 20.

Eighteen USAF-North American F-100s flew from their base in Myrtle Beach, S. C., to New Delhi, India, last week to participate in exercises to test India's air defenses. The squadron took 44 hr. to reach New Delhi and was refueled in mid-air eight times during the 19 hr. of flying it took to cover the 10,000 mi.

The F-100s were joined in New Delhi by 13 Whiteknights Gloster Javelin that flew from Britain, and two English Electric Canberra that flew from Australia. The aircraft will be used in current exercises to test and train about 4,000 Indian air men and their 100 aircraft (AW Nov. 4, p. 12).

Another Taylor Victory

Army Gen. Maxwell D. Taylor won another of his long-fought military reorganization objectives recently when Defense Secretary Robert S. McNamara transferred from the Navy to the Army-USAF Strike Command the responsibilities for defending the Middle East, Southeast Asia and much of Africa.

Adm. Arthur W. Radford (ret.) and USAF Gen. Nathan F. Twining, (ret.), chairmen of the joint chiefs of staff during President Eisenhower's administration, opposed Gen. Taylor's proposal on the ground that Navy support on studies rather than operating from a fixed base along with USAF support, offered maximum mobility for tactical warfare operations. But Gen. Taylor, current joint chiefs chairman, sold his idea to McNamara.

Army Gen. Paul D. Adair, who heads the Strike Command, is expected to establish a secondary headquarters in the command area. He command components the Middle East, Southeast Asia and Pakistan and Africa south of the Sahara. It is the first time the Strike Command has been given permanent area responsibilities. McNamara said the change would consolidate the command formerly fragmented among several commands.

Watch for Federal Communications Commission to finalize its Communication Satellite Corp. rules to satisfy customer objectives. That FCC's plan to review proposals of \$2,500 or more would result this and tape. FCC is expected to issue the review figure by \$25,000 or \$30,000.

Cost Effectiveness

Cost effectiveness studies, which led Secretary McNamara to choose a conventional rather than a nuclear-powered carrier, have exposed several stories in the Postage. One is the analysis of the broken switch vs. the one 10 seconds slow. The Defense Dept. cost-effectiveness study showed the broken switch was better since it was right there a day, while the slow one was right only once in eight years. Thus there's the war about the son of a cost-effectiveness specialist who begged about how he saved a quarter by running behind the bar at the way home from school. His father complained "Why didn't you run behind a crib and save \$1.50?"

—Washington Staff

Defense Withholds Advanced ICBM Funds

Action delays Phase 2 studies of next generation missile; reliance on Minuteman system to continue.

Defense Dept. has not yet released funds for advanced ballistic missile Phase 2 studies, indicating strongly that the U.S. will rely on the Minuteman for its retaliatory capability for the foreseeable future.

Phase 1 studies on the advanced weapons have been under way about a year (AWM Mar. 11, p. 34), and studies have been expediting Phase 2-related designs as the next step.

The missile and its deployment concepts were established after intensive in-house analysis by USAF's Ballistic Systems Div.

Then are authorized to investigate retaliatory missile capabilities in action portion of new weapons (those which require midcourse early in the 1970 decade). If developed to operational status, they were viewed as a possible means of providing a sophisticated and verifiable strategic force for the and the potential of the Minuteman ICBM in its fixed, land-based deployment.

Advanced Minuteman weapons embody refinements not in the first stage, nor can be deployed completely before 1968. Some studies are being completed for advanced missiles incorporating large solid propulsion motors and new modes of development (120 in. dia.) and in flexibility of deployment (1968-1975).

Concepts for advanced missiles and related aspects included under the R&D-sponsored Phase 1 studies include, these categories:

• **Advanced launch**, concerned with the "launch" missile or on intermediate

rise in the surface, where it would be triggered automatically by air command.

Deployment of the submarine would involve wave depression, adding to the vulnerability concept offered by the water. The water also would afford protection against radar detection, and would be a good shield for nuclear absorption.

• **Advanced packaging**, a study of the feasibility of encapsulating the missile for land-based mobility, including command and independent. According to the on-demand components in the missile to achieve an untended capability for at least two years. Studies are conducted by Lockheed Missiles and Space Co. and General Dynamics/Astronautics, are scheduled to be completed by Nov. 15.

The attitude toward continuation of the study is no more encouraging for the defense as the study is being analyzed. The concept also is contrary to Navy interests, and probably would create an inter-service squabble.

• **Global range**. Studies are completed at the end of September by Boeing Co. and McDonnell Aircraft Co. They are said to be developing feasible approaches for large missiles—perhaps as heavy as 100,000 lb—with enough range to circle the globe in any direction. A potential concern would have to include ground defense capable of pointing in any direction. Resisters of the Defense Dept. at that altitude designs could be justified against such a weapon within the time period, such as development. These designs might be in the form of very high acceleration anti-ICBM missiles for interception in various intercept phases of the incoming vehicles at various forms of intercontinental missile from a satellite.

• **Large payloads**. Feasible studies completed at the end of September by TRW Space Technology Laboratories and Martin Co. considered a spectrum of small to large payloads and weights, despite the title of the study. Indications are that approval of Phase 2 studies will be withheld because payload capability now possessed by the U.S. is considered adequate. Greater gains can be obtained through improvement in missile guidance systems, with even small warheads as accurate effecting effects of large warheads in payload weight in flight.

• **Land-based mobility**. Studies by United Aircraft's Composite System Center and TRW Space Technology Laboratories are to be completed by Dec. 31. The studies were designed to involve various forms of a mobile missile—conventional and nuclear—mounted on a wheeled carrier which would be air-transportable. That con-

cept anticipates that defense would be prepared in which the missiles could take cover. Because some studies that the missiles would be provided, location of the mobile carriers would be extremely difficult. The current configuration of the mobile carrier is land-based, which has gone through a progress derivative phase but has not yet been accepted for development by R&D, is considered a ground-based short on land-based mobility.

Defense Dept. resources are not expected to approve any Phase 2 studies for land-based mobility because it is not that there is enough information available to permit development of a true package in the concept category if it should be decided to proceed with early program in the next year.

• **Extended deployment**. Scheduled for completion by Jan. 15, 1969, this study by Martin Co. analyzes the feasibility of mobile placement at numerous strategic locations around the world. Its concern is that the mobile nature of the missile, and that R&D now would prefer to substitute land-based defense to compensate for early warning deficiencies. Because of this situation the probability is that request for Phase 2 studies is positive early, assuming will

Calibration Satellite

Air Force System Command's Electronic System Div. is testing program for a mobile satellite that will be used to calibrate ground tracking antennas. The device was a satellite with a low-orbit defense satellite of being launched by a standard launch vehicle under way for its first satellite launch.

Tests were completed by the end of September by Hughes Aircraft and North American Aviation. They were intended to analyze feasibility of performing various sciences of complete capability in order to obtain reliable data of missile impact against a specific target. This would allow launching of various missiles in sufficient time to save them from destruction.

Indianians are that the study continues first, completely possible to use a mobile satellite. The study of the air, and that R&D now would prefer to substitute land-based defense to compensate for early warning deficiencies. Because of this situation the probability is that request for Phase 2 studies is positive early, assuming will

never be made in the Defense Dept. • **Associated studies**. These include analysis of global ranging guidance (General Dynamics/Boeing), inertial guidance (Boeing and General Electric), encapsulated missile guidance (AC Spark Plug and Sperry Rand), and command and control (Boeing Co. of Aerospace Sciences). Phase 2 studies should be completed by April, 1969. Although conducted as separate studies, these studies must be coordinated with the missile concept studies. Indications are that the entire package of studies will be extended into Phase 2 studies because of its specific relation to the advanced missile concept.

Another implication for Phase 2 studies is lack of funding. Phase 1 studies were funded by \$10 million in Phase 2 studies, \$15.5 million. For the Phase 2 studies, \$15.5 million had been requested by R&D in Fiscal 1964. This was denied by Air Force review to \$10 million. A further cut, to \$5 million, was made by the Defense Dept., but only \$5.5 million of this was later approved by the Air Force. However, the funds have not been released in effect, this means the study can be continued now by R&D for Phase 2 studies.

Gilpatric's Records Are New TFX Issue

By George C. Wilson

Washington—Senate investigating subcommittee soon will confront Russell L. Gilpatric with records detailing his relationship with General Dynamics while deputy defense secretary in an attempt to prove he should have disengaged himself from participating in the F-111 (TFX) tactical fighter decision.

Gilpatric was among the civilian leaders who recommended General Dynamics for the \$7 billion contract even though Boeing had submitted a lower bid and was unanimously recommended by the USAF. Navy secure attention board. He announced his intention of leaving his Pentagon post several months ago.

Several subcommittee actions will allow the hearings room—probably Nov. 15—that records of some of Gilpatric's correspondence and telephone conversations contrast sharply with Gilpatric's claims that he had several conversations with General Dynamics and its clients when he became deputy defense secretary.

Gilpatric denied the General Dynamics account for Coworth, Secord & Moore before assuming his Defense Dept. post Jan. 25, 1967.

The same subcommittee staff that obtained letters from Gilpatric were to Navy secretary on behalf of the Coast Guard National Board of P. Worthen, gathered the material about Gilpatric (AWM Oct. 28, p. 22). Gilpatric resigned his post before the subcommittee questioned him about the

At his Senate confirmation hearing Jan. 17, 1967, Gilpatric said "Before I take office, if I am confirmed, I will resign of course from that firm [Coworth, Secord & Moore], but I will have no financial or other interest in it, except that I will be paid some of money that will amount my interest in work that was done before I left the firm, not large sums of money, but sums that represent my interest in the work of the firm for past periods."

"But, I repeat, I will have no interest whatsoever in the future fortunes of the firm, and I will never my connection with it."

Some senators and representatives of such are challenging whether Gilpatric fulfilled that pledge and the forthcoming subcommittee disclosures—especially the record of telephone conversations—may broaden the congressional challenge. Sen. Edward L. Brooke (R-Wis.), for example, last week wrote Gilpatric asking him how he could act "so irresponsibly" in leaving General Dynamics in Deputy as defense secretary in light of his close association with the firm. Rep. Bill Strauss (R-Wis.) said in a recent speech in his home state—where Boeing, which led the F-111 contract, is based—that he had "a hunch"—"I don't think there is any doubt there is a direct cut case of conflict of

Continuing Military Aircraft Need Seen

"The military aircraft is far from dead" because the U.S. will need a third different form for "years to come" and cannot afford to rely solely on the tactical combat, Chairman William P. (D-IL) of the House Armed Services committee subcommittee said last week.

He told the American Institute of Aeronautics and Astronautics and the Air Force Science Council at a joint meeting in Dayton, Ohio, that the airplane would be replaced by an available weapon because technological advances, including space capability, will be made. He said that more combat air would have the U.S. in a disadvantage if Russia developed a missile defense.

Rep. Pugh called Defense Secretary Robert S. McNamara's recent decision to build a conventional rather than nuclear version (AWM Oct. 18, p. 44). He said the "conventional projects" discarded "The overwhelming weight of evidence is in favor of a decision of conventional project." "To me this is the best of decisions of the House. Pacific Railroad, leading to produce a strong engine despite the power experience with diesel. The plan that if that is not a very—a very—a modern Navy will be needed," he said. "The computer project cannot take us as far as the commanding officer of the Enterprise, that during the Cuban crisis the nuclear missile version of the Enterprise accomplished missions which would have been impossible with a conventional version."

Overcoming the present field of research, Rep. Pugh said. The technology in research and development is now. The day of (distant) objectives for R&D programs, at great expense in cost, of thermal and overlapping management support body is rapidly coming to an end. "I believe the close research, Congress is going to get for space funds at the end of the year. Research attitude now prevailing.

Effort Urged to Ease Effect of DOD Shifts

By Katherine Johnson



Breguet STOL Uses Brussels Heliport

Breguet STOL, shown above during landing at Brussels' downtown heliport, recently completed Europe's last of four contracts for a contract lot of 680 light boats and 1,000 landings. Additional collection of the 141 (NW July 29, p. 42) is under way in France by U.S. affiliate McDonnell Aircraft Corp. holds U.S. license and will sell the aircraft McDonnell 141E. Production version of aircraft will be ready by second half of 1967. Operational version is scheduled for 1966.

which was originally set at \$20 billion.

In reaffirming the U.S. capability to accomplish its Apollo landing by 1970, Mueller acknowledges there are some technical problems which may require "alternate" development efforts. He said development of the Apollo fuel cell, navigation and guidance and attitude control systems are pushing the limits of general technology.

"I'm not saying these systems are in trouble," he explained, "only that they are examples of areas in which we may have problems."

Mueller's overall appraisal was one of optimism. He said the U.S. has a good chance of overtaking the Soviet Union in space within a few years, although the USSR for a time will have the superior capability. He referred specifically to the Polot 1 maneuverable spacecraft and indicated less specifically that he expected more (space, rendezvous and possibly docking flights by piloted Vostok capsules).

Mueller said the U.S. ability to outpace the Soviet Union in space achievements will depend on the action Congress takes on the NASA budget for Fiscal Year 1964 and 1965. The agency had asked for \$3.7 billion for Fiscal 1964 and this was cut to \$3.15 billion on the authorization bill approved by Congress.

The House made another cut to \$3.1 billion when it considered the NASA appropriations.

The space agency has asked the Senate Appropriations Committee to restore the \$250 million cut out of its budget by the House.

U.S. confidence that technical and scientific problems in carrying out a manned lunar landing can be solved continues sharply with the caution and concern which room in statements by Khrushchev.

"When we talk about the technical possibilities of doing this [manned lunar landing] and when we have complete confidence that wherever it went to the moon we safely be sent back, then it is quite feasible," Khrushchev said last week.

Lewis Chemist Makes Magnetic Rocket Fuel

Magnetic rocket fuel has been successfully created by a propellant chemist at the National Aeronautics and Space Administration's Lewis Research Center.

The discovery may open the way to the use of magnetic forces for control and orientation of rocket propellants under zero-gravity conditions, thereby

avoiding cavitation and facilitating space control.

S. Stephen Papp, a chemist in the chemistry and energy conversion section at Lewis, has magnetized JP-4 and other liquid hydrocarbons by moving small particles of magnetic ions made with the liquid and forming stable colloidal solutions. For space tests under zero-gravity conditions, an electromagnet located near the propellant pump could be used to pull the magnetite (small particles) into the pump, Papp said.

In addition to JP-4, he has succeeded in magnetizing carbon tetrachloride and normal heptane. The NASA chemist says it is a reasonable to assume that other hydrocarbons (propellants) can be made magnetic. So far, Papp has not magnetized any oxidizer or cryogenic fluid, nor has he yet tested the magnetic fuel as a rocket engine.

The development, for which a patent is being sought, is still in a very early stage, Papp pointed out, and there are many questions that will have to be answered before the feasibility of magnetic propellant control is established.

The next step in this program at Lewis will be a study of the loading and hot transfer characteristics of magnetic fuels in a weightless state, using an analog magnet to balance out the force of gravity.

Washington—Major government-industry planning about next future changes in defense procurement was called for last week before the Senate subcommittee by Deputy Secretary of Defense Russell L. Gilpin.

"The initiative puts with us," Gilpin told the subcommittee, "We haven't done much... industry is waiting for us to take the lead... I think industry is receptive" to planning a smooth transition from defense business to civilian business if military requirements change.

Gilpin outlined the impact of defense spending on the overall economy. The "hard core" of military spending for defense with conventional, non-nuclearly possible weapons is only about 2% of the gross national product, he said. He commented that the problem of cutbacks in defense spending has been exaggerated and "thought of as insurmountable."

Sen. Edward M. Kennedy (D-Mass.) expressed optimism and disagreement. He said that the impact of defense cutbacks could be severe and severe on the industries and communities affected, even though the recession on the overall economy may not be great.

Senate Hearings

Gilpin opened a series of hearings on the economic implications of defense spending by the subcommittee which will run for a few weeks (AW Sept. 30, p. 18). Companies tentatively scheduled to testify include: Boeing Aircraft Corp., Hughes Aircraft Co., Northrop Corp., North American Aviation, Westinghouse Electric Corp., General Electric Co., Douglas Aircraft Co., Lockheed Aircraft Corp., Aerojet-General Corp. and Martin Co.

The subcommittee's objective is to stimulate planning for defense spending shifts-including reductions that might result from disarmament.

Legislation introduced by Sen. George McGovern (D-S.D.) and now pending in the Senate Commerce Committee would establish a National Economics Commission in the White House to manage such a program. Its membership would include the Secretary of Defense, chairman of the Atomic Energy Commission, administrator of National Aeronautics and Space Administration, director of Arms Control and Disarmament Agency, and the heads of other major agencies.

Sen. McGovern's initiative would require all major AEC and Defense com-

panies to carry a stipulation requiring the committee to establish an Industrial Conversion Commission to plan for conversion to civilian use and should a defense contract be curtailed or cancelled. The White House commission would have the authority to appoint members of these industrial conversion and set their salaries. The cost would be included in the contract.

Gilpin commented that Defense Dept. recognizes the important potential problems and opportunities as shifts in defense spending.

Gilpin said that Defense's \$50 billion-a-year spending is not excessive.

• About \$20 billion goes for salaries and allowances to government and civilian employees. "A large proportion of whom could find positions in equivalent or better social and economic levels if they chose to seek non-defense employment."

• About \$10 billion goes for such products as clothing, automobiles, farm products, etc. "However, these are not serious conversion problems provided the civilian economy is healthy and growing."

• About \$10 billion, a far smaller, hard goods. "Other manufacturers could, provided the economy was firm, readily

convert to civilian markets." In this category, Gilpin included truck and transport plane producers and "other products in civilian use components of tanks, nuclear and other weapons projects."

• Another \$10 billion is the "hard core" military sector of the economy which would be hard to change over to civilian uses, at present \$10 billion, which is a rather small amount to begin with and is reasonably convertible to non-defense uses.

Economic Impact

Gilpin said, "There is no reason that the economic impact of defense programs—whether they are major budget shifts either up or down, or from the shifting pattern of procurement within a narrowly study budget—would be so serious as to cause serious disruption or distortion of our overall economic position."

He said he hoped for a decline in defense spending, but that even if there were increasing in military spending "there would still be excellent changes in the pattern of government... there would still be shifts in expenditures and hence changes, these would still be progress maintenance and development."

Schriever Disputes 'Plateau' Theory

Durham, N.C.—Gen. Robert A. Schriever, commander of the Air Force Systems Command, disagreed here last week with those who claim there is nothing left to invent and that there still is a potentially rich field of development for military aircraft and other uses.

"Some of our scientific colleagues proclaim that we have reached a technological plateau and we should sit back and rest the benefits," Gen. Schriever said. "I'm very much afraid that unless we push the way in research and development and push hard in some of these areas we might be going the other way, the worst possible way."

"I think it's generally agreed the U.S. enjoys strategic superiority over our Soviet enemies. This does not mean stop. There's a long job ahead."

Gen. Schriever said a Vehicle Design and Propulsion seminar sponsored by the American Institute of Aeronautics and Astronautics and NASA's Aeronautical Systems Div. that Air Force Systems Command had sponsored some 40 possible future aircraft concepts. Technologically he said, it is possible to develop for some aircraft that would be perfect.

Some specific future projects are included in Gen. Schriever's report: • Follow-up to the B-72 should be identified and the specifications written. USAF expects a final award contract should have been completed. Project Breguet offered on the characteristics of the B-72 follow-up as well as within the date of the sub- to fill the second aircraft role in such a form.

• Prototype construction is likely to be initiated in the Air Force. "We feel this makes sense," Gen. Schriever said, "building a few models without commitment to major system risks."

• Research and development program may be in the CONARC area as well as in development. Application of technology to the other CONARC area is virtually untried, Schriever said. He also said the need for some work on VFLC systems for support and offensive action in CONARC and limited war situations.

• CX-4 heavy transport may not fit the specifications now under study. "We can develop a better than those laid out for CX-4," Gen. Schriever said the AIAA-ASD meeting.

German Defense Minister Orders Plans to Buy TF-104Gs Shelved

Bonn—West Germany's Defense Ministry is shelving plans to buy 33 additional two-place Lockheed TF-104G supersonic trainers direct from the U.S. The move is intended to emphasize its displeasure over the "factor" employed by officials of the American company in their almost successful effort to sell the C-130J transport to the German armed forces at the expense of the Franco-German C-160 Transall (AWN Oct 28, p. 25).

The extent of the displeasure and the reasons behind them, Minister Erwin von Haeckl's decision to publicly chastise Lockheed are still largely a matter of conjecture.

But late last week, Lockheed Chairman Goodland flew to Bonn, apparently as a direct result, to visit Bonn. Several days later von Haeckl issued a formal apology, although no written or verbal protest had been received by Lockheed. Von Haeckl reportedly objected to what he considered unethical sales campaigns on the part of Lockheed.

Von Haeckl was disturbed by the alleged lobbying tactics within the leadership by a Lockheed-Marietta team which hoped to win direct procurement of the C-130J and the Transall before a final decision was made as to a replacement for the aging Nord Noratlas passenger transport. He told reporters that the company had "confused" the public and members of the Bundestag, and added that "the Lockheed affairs will not come into my office."

Marietta Sales Team

He later criticized the prohibition to the members of the Marietta sales team. A Defense Ministry spokesman said the ban did not extend to Lockheed as such. Other officials explained that, aside from actual lobbying, Lockheed placed articles in the West German press which tended to put the Transall in a bad light and generally exaggerated the C-130J performance capabilities.

Lockheed, not unusual in becoming involved in a public debate with a major customer, has declined any comment thus far. However, officials dispute the contention that an obstructive reorganization of the C-130J performance was made during the various presentations Lockheed "would be foolish to give out false figures when it was putting in as an evaluation when everything would turn up anyway," one source said.

There was no formal notification that plans to purchase the 33 TF-104Gs had

been altered. The Defense Ministry spokesman said last week that all formal contracts already negotiated with the U.S. firm will be honored.

This includes continuation of the still controversial European multi-national production program for the Mach 2 TF-104G supersonic fighter, a project in which West Germany is the team partner.

The country also now has 85 TF-104Gs which were purchased directly from the U.S. The new order was to have supplemented the trainer aircraft located in Germany and in the U.S., to which a mutually large number of West German pilots are sent for transition training, primarily because of the poor weather which hampers much of Central Europe throughout much of the year.

Whether the supplemental order will be placed after a cooling off period, or simply be scrapped, is not known.

Lobbying Complaint

One German official complained that the lobbying by the Lockheed-Marietta team, which has now returned to the U.S., "was a reflection on us as a country" though we could be bought off.

Lockheed supporters tend, to the other hand, that the sales effort was made primarily on a technical basis. They add the better range and performance of the four-engine C-130J, as well as a possible lower unit cost because of the U.S. Air Force orders, were emphasized in discussions relating to the proposal to purchase the four-engine Transall. Their German counter-part countered that the smaller Transall confirms more closely to the requirements for operations within Europe.

Another major factor in favor of the Transall is the fact that it will be built and assembled in West Germany in cooperation with Nord of France, to fill a need to keep the nation's industry gradually upgraded and its engineering team strong.

The C-160 will be built in West Germany by two German firms—Hawthorne Flugzeugbau and Weser Flugzeugbau—to place it at a crucial time when West Germany's industry will need new work to keep it moving at its present pace. The C-130J, on the other hand, probably would have been purchased directly from the U.S.

Final production Transall is scheduled to roll out in January, 1975. Next year, the French and German firms working together plan to turn out six pre-production models of the aircraft.

Titan Flight Successful

Martin Co. and Air Force late last week were making a detailed analysis of the successful flight of the 32nd Titan 2 vehicle launched from Cape Canaveral on Nov. 11 to test a number of possible modifications for the Titan-Geminis launch vehicle.

There were indications that the problems in the vehicle resulted in gravity forces of less than 0.5. It was not known late last week whether the low loading resulted from an atmospheric density experiment (AWN Nov. 4, p. 56) installed in the vehicle.

The Titan 2 now once impacted into the splash network 5,180 mi. down range. An Air Research Service crew for the first time recovered a payload which also was carried on the vehicle. The contents, attached to a pod on the second stage, contained instruments to measure vibration density and acoustic environment.

Garrett, Signal Oil Continue Merger Plan

Garrett Corp., which ended an all-time high for Caterpillar-Wright Corp. to buy a major stock minority, last week said it would continue plans to merge with Signal Oil and Gas Co. (AWN Oct. 23, p. 31).

Special stockholders' meetings have been scheduled to consider the proposed merger. Garrett's will be held Dec. 19. Signal's will follow the next day. Two-thirds of the shareholders in the Los Angeles-based companies must vote approval before the merger can be effected.

Caterpillar-Wright abandoned its attempts to buy 780,000 shares, or about 47% interest in Garrett, after twice extending its offer deadline and raising its offer from \$50 to \$57 per share. Garrett stock ownership increased from 54% at the time of the original offer (AWN Sept. 16 p. 39) to more than 55% at one point last week.

Caterpillar-Wright would not say how many shares it was offered. It said those which had been tendered would be returned. One spokesman said that if Caterpillar-Wright had acquired 494,000 of the 1,471,574 outstanding Garrett shares it could have blocked the proposed merger.

Garrett last week also withdrew a federal court suit it had filed in an attempt to prevent Caterpillar-Wright from acquiring and voting shares.

At Garrett's annual meeting last week, some stockholders challenged the wisdom of continuing merger plans in view of company reports of increased sales and earnings. A company official said the merger would prevent future attempts to gain control of Garrett.



A-3 Firing From Sub Shown

First successful firing from a submerged submarine Oct. 26 of Polaris A-3X Burt Submarine missile (AWN Nov. 4, p. 32) is shown in sequence as missile breaks water (above) and ignites a fraction of a second later (below), entering boost phase of trajectory (right). The 31-ft long, 54-in. dia Lockheed missile was launched from USS Yellow Hammer, moored by its pier crew, lying about 40 ft below the surface in an oil Cape Canaveral. An air-Gemini first stage burned about 62 sec and the Borealis Poodle Co. second stage about 58 sec. A-3X flew 2,000 mi down Atlantic Missile Range, guided by General Electric off-board guidance system.



Air Force, Navy Pressing NASA To Improve Reliability of Scout

Washington—Air Force has been forced to continue to use the Douglas Thor Agena 1 launch vehicle, despite agency attitudes because the cheaper Scout solid propellant standard launch vehicle (SLV-1A) continues to demonstrate low reliability. Navy is also experiencing difficulties in using the Scout to launch the operational configuration of its Transit navigation satellite.

Both services have been pushing National Aeronautics and Space Administration, which is charged with management of the project, to correct deficiencies in components, particularly in government furnished equipment (GFE). The NASA project office is responsible for GFE's continuing operation, making sure of the system, and their component parts such as motors, up to and including.

A team of management and engineering personnel from NASA, based at NASA's Langley Research Center, is planning to visit the Delta plant of Ling-Tecum-Vought, the prime vehicle contractor, last week to review the program with the aim of correcting the faults.

Air Force has had better success with

Scout than the Navy, due mainly to various engineering and technical development failures of the Air Force-sponsored Aerospace Corp. Even though Air Force gave components exceptionally thorough tests, meeting those that showed poor reliability, the USAF could not learn from its mistakes.

When it appeared that several high priority Air Force programs would be affected by Scout failures, alternate launch vehicles were investigated. That had proved its reliability over a period of development launches from Vanden Berg AFB, Calif., and Cape Canaveral, beginning with the Discoverer was the standard upper stage in the Lockheed Agena B.

As two projects requiring needed operational status, payloads were scheduled in weight so that the full 1500 lb. initial capability of the Thor-Agena combination is not required. Scout was chosen to ease the lighter loads on the system.

When the low reliability of Scout became apparent, Air Force kept its program going with the standard production Thor and Agena B stages. In fact it had an excess inventory of the Agena B vehicles, and Thor production and scheduling were maintained. To date more than 100 of the Thor-Agena B combinations have been launched. Excess payload capabilities are being up with a variety of payload loads.

The Air Force however still wants to introduce Scout into its program where payloads are sent into low earth orbits, because of lower cost and faster reaction time of the vehicle.

Navy, on the other hand, does not have the funds to conduct thorough checkout of the components, although it could be done so by paying the Air Force to perform the work. As a result it had a 50% failure rate with the Scout in its operational Transit launches. It has no other booster available, as does Air Force.

The operational Transit satellite weighs 150 lb.

SLV-1A consists of three stages. Stage one is powered with an Aerojet AG-1A, XM-88 engine producing 105,000 lb. thrust; stage two, a Thiokol-Centaur XM-75-1, producing 64,000 lb. stage three, a Hercules-Algeps-Belluore Laboratory (ARL) ARL-1, XM-99 producing 19,000 lb. stage four an ARL ARL-2, XM-75, producing 1,000 lb. thrust. The second stage package is produced by Minneapolis-Honeywell.

Scout is designed to place 150 lb. in a 400 mi. alt orbit and 240 lb. into a 300 mi. alt orbit.

F-5 Briefing

Los Angeles—Norwegian military group was briefed here recently on a version of Northrop's new F-5 aircraft which would perform in subsonic role.

Stripped of guns and fitted with extra fuel tanks, plane would mount external air-to-air missiles. Norway may be interested in about 30 of these planes initially, and no U.S. funds would be contributed.

Discussion also was being conducted by North with South Africa by sale of two, possibly three, airplanes of F-5As with full armament and air-to-ground capability. No U.S. funds would be received, and equipment contracts that all services, except Norway, would be done by North-contracted personnel.

Ping Pong Rocket Development Funder

Another development is under way of Lockheed Aircraft Corp.'s Ping Pong lighted rocket reconnaissance satellite (AW Dec 10, p. 25) under an Army contract.

Lockheed's Martin & Spore Co. completed the concept for a small rocket with a motor at each end that could be fired into an orbit for short range, make photographs there and be refired before being for return to U.S. base. Ping would slip to the base prior to firing of the second engine for stability on the return flight.

Navy a Lockheed California project, Ping Pong has been funded by that service through demonstration to the Army with a rocket using off the shelf components wherever possible.

One problem associated with the concept has been the potential vulnerability of the rocket at the base of return fire, at which point it will be stationary on the air for an instant.

YS-11 Schedule Delayed

Contributors of the YS-11, Japan's first jet and World War II technology transport, has been delayed four months to permit modifications based on flight test results (AW June 15, p. 16).

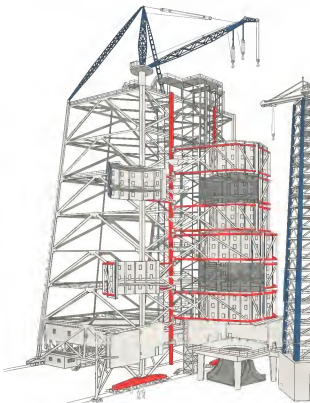
Contributions by Japan's Civil Aviation Board and the U.S. Federal Aviation Agency now is scheduled for late 1963. Nissan Aerospace Mfg. Co., which has flight-tested two prototypes, and two modifications would be made.

• Installation of a wing-folding system in the fuselage, elevator and ailerons to increase aircraft controllability.

• Increasing dihedral angle of wings by 2 deg. to improve lateral stability.

Part five contract, which goes to Agency government agencies, will be delivered five months later.

The biggest thing on wheels in the world



Phonon Laser Devised

New laser material that operates on an unusual principle has been described by Bell Telephone Laboratories scientists. The material, supposed to be made of silicon with metal ions, would absorb infrared energy at a wavelength of 1.62 microns while simultaneously generating vibrations, called phonons, in the crystal lattice of the material.

Unlike previous laser materials in which the wavelengths of released energy were determined solely by the energy levels of the atoms, for the new material's wavelength is determined both by the energy states of the metal ions and the vibrations of the crystal lattice near them ions, ETL reported. The metal ion is excited (pumped) to a higher energy state in conventional manner and then relaxes to an intermediate energy level. From this level they fall to the lower laser level, giving off infrared energy and simultaneously setting up a vibration of the crystal lattice.

By the largest the energy level of the vibrating crystal lattice, the longer the wavelength of the emitted radiation. ETL said the crystal experiments, the laser crystal was operated at temperatures of 20K and 79K.

The photo (below) illustrates the crystal was 10 million angstroms.

The Saturn space vehicle is so large that the service tower at Cape Canaveral presented a tremendous problem of size, weight and mobility. For this project, U. S. Steel was given the opportunity to help work out design concepts which would make this service structure lighter, stronger, simpler, and possibly less costly.

USS research people prepared a report on allowable working stresses using A36 structural carbon steel in combination with USS "T-1" Constructional Alloy Steel and USS T8H-TEN High-Strength Low-Alloy Steel. Then, during the next few months, many USS technical specialists spent many hours with the designers Henshaw H. Connell & Associates, and the U. S. Army Corps of Engineers. The result was this unique mobile structure which took full advantage of the properties of these three steels in plate, structural, and tubular form, that made this structure possible. Credit for the design goes to the National Aeronautics and Space Administration, the Corps of Engineers, and to the Connell group. U. S. Steel backed them up with thorough metallurgical and engineering data.

The greatest portion of the burden fell to reliable A36 structural carbon steel. It represented 73% of the total steel used. Careful research and drafting showed that the requirements for exceptional strength or close tolerance clearances could be met by application of higher strength steels amounting to less than 26% of the total steel.

1.5 million-pound-thrust Saturn space vehicles will be mated up from Cape Canaveral after being assembled in a unique service structure at Complex 37. The structure serves two launching pads instead of one, using a radial system of cantilevered silo gates that swing back against the structure like huge arms and permit the structure to move crablike between the pads.

Biggest wheeled structure in the world. Completely equipped, the service structure weighs in at more than 5,000 tons—as much as two Navy destroyers. It's more than 300 feet high, 130 feet square at the base, and it rolls on a total of 72 3-foot-diameter crane wheels, illustrated on reverse side of this sheet, at up to 40 feet per minute.

The gate problem. When a space vehicle such as Saturn is being serviced, the structure encloses the Saturn with two vertical rows of silo gates, as partially illustrated in the sketch. Each of these gates weighs 63 tons, and is cantilevered 60 feet from the front of the structure. At launch time, all gates are opened and the structure is rolled clear of the launch area.

No point bracing. NASA's design criteria demanded that the gates be capable of being infinitely positioned up and down the height of the structure to allow for future changes in space vehicle design. Thus the gate-mounting columns had to be strong enough and stiff enough to support the gates at any point with a minimum of deflection.

To make matters more complex, the gates were so big, cantilevered so far, and subjected to such off-center loads (which created enormous torsional stress) that conventional design would have made these gates hopelessly heavy—in fact, would have made the structure unworkable. Final answer to the gate-mounting columns and the gate problem was to design them with 100,000 psi yield strength USS "T-1" Constructional Alloy Steel. This steel, invented by United States Steel, is three times as strong as A7. It reduced the weight of the gates more than 50% and made possible the design of the slim 289-foot-long gate-mounting columns.

The wheel problem. When the designers lightened the gate-mounting columns and the gates with USS "T-1" Steel, they solved two other serious problems at the same time. 1) By reducing the "front" weight, they eliminated the need for counterweight—which would have been needed to prevent toppling due to wind loads

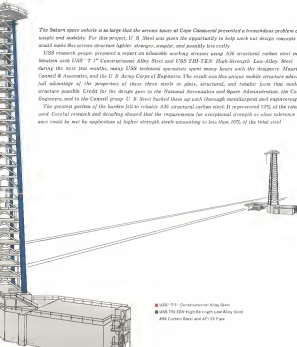
while the structure is moving, and 2) they eliminated 16 additional wheels that would have been needed to carry the extra weight of the gates and column members.

Interrelated problems. In summary, a whole series of weight reductions were possible with the USS "T-1" Steel. gates could be made lighter, therefore the gate column members and front columns could be made lighter. These weight-saving steps meant that counterweight could be eliminated, thus reducing the weight of the entire tower on the wheels.

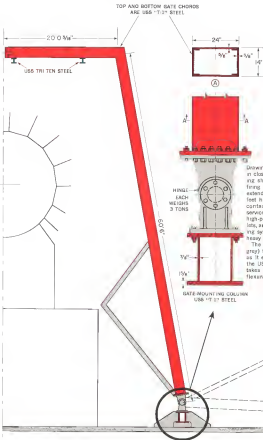
Wheel trucks. It was necessary to keep the size of the truck drivers (which tie the wheel trucks together) as small as possible. Although required strength could have been obtained by use of A36 structural carbon steel, it was decided that "T-1" Steel should be used here to reduce the size. In the final design, the truck wheel assemblies are about 50 feet long and 7 feet high at the center.

Silo gates. These gates take advantage of the properties of three different types of steel. To mount twisting, the gates are designed with horizontal rectangular box girders of USS "T-1" Steel. Trusses and vertical framing members are A36 steel, except for the two outward vertical members which face the launch pad during firing. These two outward members are made from USS T8H-TEN (A441) Steel, a 50,000 psi yield point steel, to provide extra strength with reduced weight at the ends of the gate.

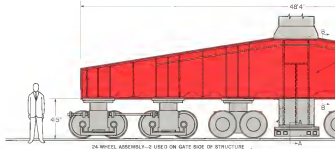
Details. The over-all structure uses approximately 5,000 tons of A36 structural carbon steel, 400 tons of USS "T-1" Steel (mainly in the gate-mounting members, the gate-mounting columns, and the wheel truck girders), 11 tons of USS T8H-TEN and 940 tons of API 53 steel pipe. T8H-TEN is also used in the overhead cranes and in the umbilical towers. The structure uses over 100 tons of high strength steel bolts. United States Steel rolled some USS "T-1" Steel plates in special lengths (to provide staggered weld splicing in the gate-mounting columns), and some of the A36 chord sections inside from 14-inch wide-flange beams are the largest ever rolled in America. The 289-foot-long gate-mounting columns were welded together in the vertical position while maintaining absolute alignment. Since gate hinge mounting holes were predrilled every 6 inches, spacing had to be maintained between adjacent plates and between the two gate-mounting columns.



■ USS "T-1" Constructional Alloy Steel
■ USS T8H-TEN High-Strength Low-Alloy Steel
■ A36 Carbon Steel and API 53 Pipe



"B" SILO GATE—PLAN VIEW



24-WHEEL ASSEMBLY—2 USED ON GATE SIDE OF STRUCTURE

Drawing shows one of 12 gates in closed position; dotted drawing shows gate in retracted or firing position. The gate at left extends 60 feet from hinge, is 30 feet high, weighs 63 tons, and contains infinitely adjustable service platforms, illumination, high-pressure gas, electrical outlets, and a high output fire-fighting system—all brought in with heavy duty flexible fringes.

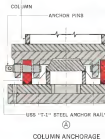
The triangular brace (shaded grey) takes torsion loads as far as it extends, but beyond that, the USS "T-1" Steel box girder takes the combined axial load, flexural bending, direct shear,

and torsional shear. Deflection is extremely important here, as gates must latch positively for hurricane protection, and mate with other gates above and below.

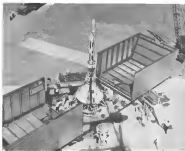
Design criteria fixed the distance between centerline of structure and rails, so limited space was available for the gate mounting columns. There are an infinite number of loading possibilities on the gate mounting columns which tend to twist the column and subject it to varying bending forces in many places. Maurice Connell & Associates ended up with 560 pages of structural calculations for the entire structure

Upper drawing shows one 24-wheel truck assembly; lower drawing shows anchorage. The 6 pairs of outboard wheels are driven by electric motors with a timing cable and the 4 pairs of inboard wheels coast. Only the trucks on the gate side are powered. Truck girder that ties wheel trucks together is made completely from USS "T-1" Steel.

Before moving, the structure is lifted 3 inches off its anchor pads by hydraulic rams that contain locking rings to prevent the structure from dropping in case of hydraulic failure. At rest, the structure is supported on four col-

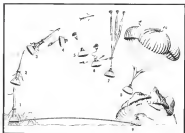


- USS "T-1" Construction Alloy Steel
- USS T-1-10N High Strength Low Alloy Steel
- A36 Carbon Steel and A75 S3 Pipe



Apollo Pad Abort Test Launch Successful

First Apollo pad abort test Nov. 7 proceeded without apparent problems at White Sands Missile Range, N. M. Purpose of launching was to test stability and operational characteristics of Apollo escape configuration. Launching was made on schedule. Third flight time was 5 min. 45 sec. Rate of estimated altitude below impact 1,600 ft./sec. pad was 24 ft./sec., compared with 50 ft./sec. for Mercury capsule. All sequences occurred within 1 sec. of computerized time, according to National Aeronautics and Space Administration, and were well within prescribed tolerances. Command module reached maximum altitude of 3,100 ft. Parachute deployed without problem. Command module came to rest on second and on 81-deg angle off vertical. Apollo bodyplate and escape tower are shown (clockwise) mated and ready for launching. Prepared flight sequence for short test (below) shows lift off (1), main motor burnout (2), escape tower jettison (3), escape deployment (4), escape line retracted and fully deployed in 34.1 sec. (5), escape chute open, pilot and main parachute deployed (6), nose parachute fully inflated (7), and command module burnout (8). Note launch escape tower turbulence at 3,700 ft. near parachute rigging. There was no apparent internal or external damage to the command module.



USAF Effort Seeking Simple Inertial Navaid

Los Angeles-Air Force has initiated a design effort aimed at developing a simple, reliable and low-cost inertial navigation system applicable to all classes of manned military aircraft. It was requested here last week in the Low Cost Navigation Symposium of the Institute of Navigation.

Aim of the in-house effort is to make possible an inertial system with a lifetime of 2,000 hr., an accuracy of 1 unit per hr. and a price of \$25,000 in production quantities of 200.

[For a report on possible future use of inertial navigation systems, see p. 51.]

Air Force plans to have six prototypes of the system completed in two years.

Emphasis in the development will be on simplicity and reliability, with lower cost a consequence. As many components as possible will be eliminated, unless simplified. Minimum use will be made of cost rather than mechanical parts. The number of close tolerances in measuring machined parts will be reduced. Ultimate in cost-cutting measures is contained in a long list of reliable and reliable power source.

Minimality will be used to cut computer costs while microcircuits are used with programmable systems will be mounted on the ground. A number of systems, now simple systems such as the Kinetic Gyroscopes (AW Sept. 5, p. 10) will be tested for possible inclusion in the final design.

System outputs are expected to be in the form of longitude, latitude and ground speed.

The effort is coordinated by a group consisting of all Halliburton AID under the technical direction of William A. Beards. The group is part of the Air Force's Advanced Laboratory located at Aeronautical Systems Div.

Work Stoppages Drop Sharply at ICBM Sites

Washington—Work stoppages due to labor disputes at missile activation sites are among the new point according to a report to the President by the Missile Sites Labor Commission.

During the year ended in the report—June, 1963—June 1963—over 99% of all available work time on missile sites was free of work stoppages. The last time was last year (67%).

Within the two-year period in which the commission's report stated the record has declined from one more day lost in every 100 worked to one lost for every 1,177 worked—a reduction of 1,200%.

Navy to Allow Plastic, Glass Fiber In Construction of COIN Aircraft

Washington—Use of plastic and glass fiber structural materials, including aluminum alloys will be permitted by the Navy in construction of the light counter-aircraft (COIN) aircraft. The restricted restriction has been a series of internal disagreements. It was necessary since the COIN concept was originated over a year ago.

In making public the preliminary type specifications for the COIN aircraft, the Navy recommended the following concept for the new category aircraft: Continental T77L, United Aircraft T77-G-2A and the T77-G-2A.

No test forced to determine the preliminary specifications to all components indicated because they were modernized or altered in a few years. In letters to Congress and individuals, the Navy of Weapons revealed the present state of affairs and added, "The main impact of the restriction of all qualified potential bidders and those interested in the program's core of the preliminary type specifications is provided below for your information."

The letters said that the COIN program has not yet been authorized, but that the type specifications would most likely be used in the request for proposals (RFP) when authorization is obtained. Dr. John McLaughlin, deputy director of research and engineering for tactical warfare programs, had stated earlier that RFPs would be mailed before the end of the year (AW Oct. 7, p. 10). Navy officials made known.

Statement of starting the project late in October (AW Nov. 4, p. 10). Proposals from companies that intend to use plastics or glass fiber must show how much of these materials will be used, whether the prime is a sub-contractor will do the work and what the qualifications are of the firm in this type of work. Any development effort that has gone into applications of these materials must also be described. Further plastics will be permitted in use stabilizers and for a wingbox case.

Engines will be furnished by the government. Some companies are considering use of engines other than those recommended, such as the Allison T63 and the Continental T63, both of which are in the 2500-hp class and are being developed for the Army's light observation helicopter. The engine cost, two engines would be supplied to a single propeller permitting the capability of dual-engine dual engine on each side for long endurance flying.

According to the type specifications, the aircraft will be a biplane, tandem, two-engine, light weight, multi-purpose armed reconnaissance aircraft. Its primary mission will be to provide reconnaissance, target marking, battlefield observation, and protection of helicopters, destruction of enemy helicopters, adjustment of surface fire, airborne control as coordination, liaison and liaison close air support against lightly defended targets. Secondary missions will be to land cargo and personnel transport and photographic reconnaissance.

COIN aircraft must be able to operate from primitive runways, fields and roads, usually carrying without aid, capable of steering gear and helicopter assault gear. An ultimate capability of operation on water will be required.

The program that will be described as the RFPs will call for construction of prototypes only with no promise of later production by the successful bidder.

Maximum speed will be 275 kt. at sea level with military power without exceeding external stress. Landing gear at altitude will be not less than 2 ft. Tailrotor clearance is 50-ft. clearance from a road and runway will be not more than 500 ft. Landing distance over a 50-ft. obstacle carrying 10% fuel and two ex-

traffed aircraft will be not more than 800 ft. Single engine service ceiling requirement is 10,000 ft. and the ferry range will be not less than 1,200 nmi at 1,315 ft.

On an armed reconnaissance mission, the aircraft will be required to carry four Mk. 81 bombs, four Mk. 82 or 57 mm. rocket modules and 500 rounds of ammunition for each gun. Total maximum weight for the mission would be 13,155 lb.

For a close support mission, carrying less fuel than for reconnaissance, four Mk. 82 bombs and the same maximum close range would be needed for a total maximum weight of 13,155 lb.

Design studies will be for 113 months, of which 105 will be operating. Flight hour requirement is 7,500.

Because of the ultimate water operation requirement, the capability of going from map to water and return is included. A complete amphibious capability is required.

Specifications were sent to Convair, Lockheed-California Co., Douglas Aircraft Co., Ryan Aircraft, Chance Vought Corp., North American Aviation, Inc., General Aircraft Co., Bell Aircraft Co., General Dynamics Corp., Boeing Co., Martin Co., Fieseler Aircraft Corp., Beech Aircraft Co., Piper Aircraft Co., Republic Aircraft Co., Grumman Aircraft Engineering Corp., Northrop Aircraft Corp., Sikorsky Aircraft, Jet Corp., Hill Aircraft Corp., Goodrich Aircraft Corp.

News Digest

Endure Air Lines last week asked the U. S. Supreme Court to overturn a U. S. Court of Appeals ruling that prevents Northwest Airlines to continue operations in its Florida route until April 18. The Florida court decision blocked a Civil Aeronautics Board order, denying the airline to stop all service north of New York City Nov. 15.

Moore Corp. and P. R. Millory & Co., aircraft component manufacturers, will set up a joint venture company in Rochester to manufacture rocket motors, using a Xerox-type technique of depositing thin films in isolated sections. The new company, as yet unnamed, will be equally financed by both parent organizations.

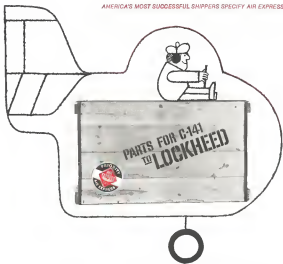
Northwest Airlines and Scandinavian Airlines System both ordered new jet transports last week. Northwest is purchasing 52, 165,000-lb. jet Boeing 720B and three 707-120 jets will cost \$13.3 million, plus \$450, 51,000-lb. jet as for two Douglas DC-8s equipped with the new Pratt & Whitney JT3D-3B engines.

George T. (Ted) Baker, 63, founder of National Airlines, died last week in Vienna. He was one of the airline industry's pioneers, and built National into a major airline from a small Florida-based carrier. He died of cancer in a hospital in Vienna. He was born in 1902 but assumed a director and president.

TransCanada Air Lines Douglas DC-8 transport last week crashed and burned at London Airport after the plane had overdone the runway threshold on take-off during a thick fog. Only one of the 97 on board was injured.

Rockwell's Div. of North American Aviation has received a \$15.6-million contract to develop a subsonic supersonic aircraft motor in the U. S. Navy's new Phantom missile Hughes Aircraft Co., prime system contractor, awarded the contract on the basis of the cost and out of Rockwell's Rockwell, Rockwell, McGraw-Hill, Inc. The motor is made in being designed primarily for the F-111B (F100) fighter.

45



Ask
Lockheed-Georgia about
Air Express speed.

AIR EXPRESS DIVISION OF



Air Express delivered 399 shipments to Lockheed in one month... 95% of them overnight!

Lockheed's business is speed. So is Air Express...the kind of speed that gets things done on time, in spite of difficulties. Example: 23% of the cities of origin for Lockheed's shipments had no scheduled airline service, yet Lockheed specified Air Express for overnight delivery.

This is how Air Express does it: Whatever the point of origin, R E A Express trucks rush shipments to the nearest airport. There they leave on the first outbound flights. (Air Express has priority on all 38 scheduled airlines — first cargo aboard after U.S. mail.) At the destination airport, R E A trucks rush shipments to consignees.

This top speed service is routine at Air Express, and it's dependable, too! Every customer gets it every time. And yet Air Express is often cheaper than many slower means. Can you afford not to consider Air Express?



Fairchild Plans to Increase F-27 Capacity in New Sales Program

Washington—Fairchild States Corp. plans to increase the gross weights certified for the F-27 turboprop as part of a program to sell more of the short-range aircraft.

Fairchild models of the twin-engine aircraft will be certified for 42,000 lb at takeoff and 40,000 lb for landing, without fuel drops, as compared with the limitations of 39,000 lb and 37,500 lb on existing models, the company said. F-27 production was suspended in September after a total production of 115 airframe and composite aircraft. Of these, only 1,275 are considered flyable, and the rest will be available in early 1964 to increase the Rof's. Since then, the Dart Seven-powered F-27 will have the option of increasing takeoff weight limitations to 42,000 lb model modifications for fuel capacity, to accept a 60,000 lb takeoff weight and 35,500 lb landing weight, without the fuel drop modifications while the new program, Fairchild said.

Fairchild also has been discussing a new lease-purchase plan with local service airlines and consignment, that the F-27 is the only aircraft capable of earning a profit under a proposed Civil Aeronautics Board plan to reduce the industry's subsidy by one third in five years (AW Sept. 23, p. 41).

Terms of the lease purchase would permit airlines to lease the F-27 for periods of three one to seven years at the monthly rate of \$12,100. At the option of the airline, a portion of the total lease payment could be applied toward purchase of the aircraft at an anticipated price of \$500,000.

Baron's Air Lines, which operates a fleet of F-27s, has been cited as a recent Fairchild which as an example of how the turboprop aircraft can reduce subsidy costs for other local service airlines by replacing older aircraft. Baron's operating profit last year exceeded \$1.5 million. If the airline had been operating an other 40-passenger aircraft, Fairchild contends, the profits would have been as follows:

- Martin 404—\$123,514
- Convair 440—\$1,017,064
- Convair 340—\$760,791
- Martin 202—\$762,601
- Convair 440—\$722,601

Applying the Board's proposed 50% subsidy reduction for last year, Baron's would at these figures be the same aircraft.

• Fairchild F-27—\$616,851

- Martin 404—\$248,600
- Convair 340—\$134,840
- Convair 340—Loss of \$172,164
- Martin 202—Loss of \$208,853
- Convair 440—Loss of \$279,994

The study was based on the assumption that each of the older aircraft operated over the Boston system would generate the same number of passengers as carried by the F-27 last year, and would by the same revenue per station per day as the turboprop aircraft, Fairchild explained.

The company contends that most of the proposed subsidy savings for the F-27 will come about through higher utilization of the aircraft, reduction of time between overhaul and improved maintenance practices, as compared with rising operational costs on the older aircraft through increased utilization, higher maintenance costs and spare parts problems.

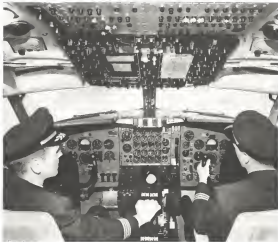
While the F-27 purchase price is higher, its ability to reduce operating costs is expected to offset its higher price on a station basis than that of the other aircraft, Fairchild claimed. In an industry-wide comparison of direct operating costs for each type of equipment for the year ending Dec. 31, 1962, and for the year ending Mar. 31, 1963, Fairchild said the F-27 rate of return would have increased from 1.5% to 6.6%. In contrast, the Martin 404 rate would have dropped from 6.2% to -8.5%, the Convair 340 from 3.9% to 0.6%, the Convair 440 from -1.1% to -8.5%, the Martin 202 would have shown a gain from -8.6% to -6.4% and a -11.2% would have been recorded for both periods by the Convair 440.

French F-28 Support

Paris—French government is studying the possibility of acquiring the F-28 F28 two-seat transport project after the 50-passenger "Canavia Junior".

After inspecting French transport minister and in a recent civil aviation budget debate that needs a policy would permit the French aviation industry to continue its potential for other projects and at the same time would avoid "costly cost policies," since the F28 project already is well established.

And Aviation probably would also join in the building of the F-28 at the same time project is accepted by both the French and Dutch governments. In any case, the minister's remarks seem to kill off the chances of a smaller French project.



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Airline Use of Inertial Navigation Seen

By Philip J. Kline

Washington—Results of a five-month flight evaluation of an inertial navigation system aboard a Pan American DC-8 indicates that inertial systems may find use in long-haul airline operations, but probably not in the very near future, according to a Federal Aviation Agency spokesman.

Purpose of the tests, which included 55 transatlantic crossings among 189 flights, was to evaluate the present state of the art in inertial navigation equipment, and to determine the operational problems when used in the air carrier environment, according to Alexander B. Winick of FAA's system design staff.

The 704k equipment used in the test was a modified version of the system built by Litton Industries for use in the Lockheed T-104C (NAV Jan. 9, 1961, p. 81). For the F-104C, the equipment was designed for short range and flight times considerably longer than those under which it was tested by Pan American.

Despite this, the equipment demonstrated errors as low as 0.7 naut. mi./hr. on several transatlantic flights, equivalent to a total error at destination of less than 5 naut. mi. Over all average for about 100 flights was 2.4 naut. mi./hr., FAA said, but there were a few flights when the equipment apparently malfunctioned and exhibited errors as high as 22 naut. mi./hr. at flight time.

The Litton equipment, which uses two displacement type gyros rather than the more widely used set of three angles-integrating gyros, employs a directional gyro that automatically seeks out the direction of true north, avoiding the need for signal alignment to an external reference.

This feature is a great convenience for military operations as well as airline operations.

However, this self-aligning process requires about 12 min. and the aircraft must remain essentially motionless during the time, according to Sidney Hershon, FAA project engineer. During one particularly gusty day, the Douglas DC-8 had to delay its second nearly 45 min. before the aircraft had fully settled sufficiently to align the system, Hershon said.

Yet overall, FAA is reasonably pleased with the results of the test program and sufficiently encouraged over the possibilities of inertial systems to want to conduct another test program in the future, providing funds become available. The test program, completed in August, was designed as a series of determining the optimum performance that could be obtained. Litton engineers were on hand to check the equipment extensively after each flight, and were free to substitute new

"logment coding" would not be suitable for regular airline operations, but its use in the FAA tests does not mean that such treatment would be required.

In a subsequent test program, if funded, equipment probably will be tested in a manner more appropriate to airline operational environment. Another change contemplated would give the pilot direct bearing signals to his selected destination, as well as displaying ground speed, distance to go and time-to-go to destination. Provision also would be made to find the



World's Fair Heliport Opened

Foot of New York Authority's heliport and exhibition building housing a restaurant and cocktail lounge has been opened on the World's Fair grounds. The building will remain open after the fair closes in 1965 if it proves financially successful. Reaching landing platform at 133 ft. above the ground and measures 130 x 300 ft. Steel Skyhook in the background is expected to handle helicopter traffic on rooftop and football game days. Scheduled helicopter service is to begin next month and sightseeing service next April (ENR Oct. 14, p. 37). Skyhook S-61 is shown on the platform.



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First American 707-320C Nears Delivery

First of four Boeing 707-320C turbofan freighters scheduled for delivery to American Airlines has been rolled out at Boeing's Renton, Wash., plant. The freighter will serve up to a 45-ton payload between San Francisco, Los Angeles, Detroit, Boston and New York. All four are scheduled to be in operation by January. Freighters are Pratt & Whitney JT4D, producing 15,000 hp thrust each.

storing signals directly into the aircraft's computer.

In the initial test installation, the Litton system controls and display were located at the navigator's station with no output provided for the pilot. The dual-redundant computer and provided only percent aircraft position, an latitude and longitude, together with true heading information.

The question of using inertial navigation systems in the new supersonic transport was expected to be discussed late last week at a meeting of airline and aerospace industry representatives held by Aeromedical Radio, Inc. (Aero) at Washington. Some observers see the inertial navigator as a direct competitor to the passively used Doppler radar navigation system, while others believe they are complementary.

The Doppler navigation system generally is credited with an error of about 11% of total distance traveled, or about a 45-m error in a 3,000-m transoceanic flight. The recent FAA tests also

found that an inertial system oriented under the conditions described, has less than half the error of a Doppler system, or about 0.7% of distance traveled, according to Heisler.

However, whereas a Doppler navigator system has an associated cost of roughly \$25,000, an inertial navigation system is expected to sell for \$60,000-\$90,000. But the expense and difficulty of installing a Doppler system is somewhat lighter because it can be cut in the fuselage to accommodate the belly entrance. Another factor for supersonic transport applications is that percent Doppler system are expected to require modification to operate at supersonic speeds, whereas percent inertial systems are already designed for such operation.

Those who see the Doppler and inertial systems as complementary point out that a major source of error in the Doppler system has been the lack of a firm-drift directional gyro as

public of providing an accurate indication of true heading. Using a Doppler and an inertial system in combination would enable the Doppler navigator to obtain extremely accurate heading information from the inertial platform, while the inertial system accuracy could be improved by using the Doppler radar gyro's electric signal.

One of the factors behind FAA's decision to proceed with the recent flight evaluation, Wack said, was the ion-flicking and widely divergent reports on the accuracy and reliability of current inertial systems. Litton's system was selected because it was the only available one available designed for aircraft with errors less than the critical value, according to FAA spokesman. Working under a \$200,000 contract, Litton installed the F-104C equipment for installation on the DC-8, and provided all engineering and support services needed to keep equipment operating properly during the tests.

The contract provided that the vendor had to demonstrate an error (in a

cross-over probability) best of no more than 1/4 statute mi/hr during the first 20 flights, after seven hours of flight, dropping to 3/8 statute mi/hr during the next 10 flights with constant and improvement during the balance of the tests. The one of the few errors by Litton was to be based on equipment performance. Any flight in which the error exceeded 7 statute mi/hr was to be treated as a malfunction, and no statistics would be excluded from consideration in "data flight." But no more than 20% of each block of 10 flights could be declared as malfunctions, according to the contract terms. During the 100-hour flight, 80% qualified with errors less than the critical value, according to FAA's Heisler.

Approximately halfway through the test, Litton substituted a new inertial platform that exhibited greatly improved accuracy, with errors averaged about 1/8 statute mi/hr. The test even if malfunctions before during a flight in Tulsa, Heisler says. Litton provided three inertial systems and made substitutions when the flight equipment malfunctioned in the company's system was to be by equipment adjusted for peak performance. On the average, an equipment substitution was made after about nine flights, Heisler says.

Four tests in the FAA tests, it was determined that transoceanic in the aircraft electric power system was running havoc with the inertial system's performance. Troubles caused when an aircraft switched from, or to, external ground power also caused trouble. As a result, Litton designed a stabilized power supply which converted aircraft 115-v power to 24-v dc and used its own small battery to add to voltage stability. The replacement in the FAA tests suggests that a special power supply of this type would be needed for operational use of an inertial system.

Litton was compared on the conventional circular error probability (CEP) basis.

Pan Am Asks Estimates

New York—Performance of the 14-ton Inertial navigation system during recent FAA tests aboard a Pan American DC-8 has caused queries for rough estimates of equipment cost in first-line quantities for long-range planning purposes.

The firms quoted include Litton, Northrop and North American's Astronautics Div. A Pan American spokesman emphasized that "considerable work needs to be done" to make the percent inertial system suitable for airline operation, and that it is likely to be at least several years before they will be used in service. However, he said that inertial systems are likely to find use in supersonic transports and possibly in existing jet airlines.



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4 Rolls-Royce is now engaged in the development of all types of jet powerplants for V/STOL production.

**A NEW PHASE
BEGINS WITH
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AIRLINE OBSERVER

► New section of the Anglo-French Concorde supersonic transport, now in mockup stage at British Aircraft Corp.'s Filton Works (AW Feb. 28, p. 151), is expected to be built in the structure for the cockpit. Drag coefficient is reduced by 0.002 with the configuration, indicating significant performance improvement.

► American Airlines is protecting its intrastate operation proposed by Trans-state Airlines in New York between New York City and Buffalo. American holds that the airline rights between the two cities must pass over New Jersey, Connecticut or Pennsylvania and the question would thus be referred to the courts under the Federal Aviation Act. Intrastate schedule flights require an operating certificate from the Civil Aeronautics Board, while interstate flights do not.

► Aeroflot is still experiencing a low reliability record with the Il-18 and Tu-114 equipment. The Eastern observer notes irregularities in the schedule between Moscow and Tbilisi, with the spare Il-18 at Tbilisi frequently needed because of mechanical problems in flights from Moscow. Russian technicians en route to or from Soviet Antarctic party, are allowed to fly only on Aeroflot and are a regular feature at Tbilisi's hotel while waiting, some three days for flights to arrive or depart. The Tu-114 helicopter transport which has usually, in New Delhi, seldom arrives on time and usually departs late due to "technical delays," sources say.

► Materials bridge program that was first encountered by a Mach 3 transport will be studied by Lockheed-Vought under a National Aeronautics and Space Administration contract. Company will do analytical investigations of wing box loads specification representing a wing structure fabricated of 0.050-inch 801-90 TiV titanium alloy and AS-150 stainless steel. Materials will be supplied by NASA. Construction techniques, including joining and spot welding, will be studied. Loads including those that a Mach 3 aircraft would experience in 20,000 ft. will be placed on the beam structure which will measure 8 ft. long, 2 ft. wide and 5 in. thick.

► Civil Aeronautics Board split in several different directions in its order calling for an investigation of the 5100 jetliner when coast-flown a fare proposed by Pan American World Airways and reluctantly adopted by United Air Lines. Chairman Alan S. Boyd and Member Cass Casey filed a joint statement of concerns, and dissent. Vice Chairman Robert Murphy and Member C. Joseph Murphy filed separate statements of concurrence and dissent. Member William C. Randall concurred without dissent. Basis of the dissent is whether the third class fare should be applied only to aircraft with a high density seating configuration, as Pan American wants, or to aircraft with standard overhead bin configuration, as United proposes.

► Airlines' proposal for publishing liability limitations on international travel under the Warsaw Convention (AW Jan. 1, 1967, p. 20) has been disapproved by the CAB. Carriers suggested providing a statement that covered liability for injury or death may be limited to \$8,250 on international travel and that additional coverage may be purchased from private companies. Statement would be placed in passengers' ticket envelopes. The board held that the carrier "does not adequately inform the traveling public" and that its use "would tend to create confusion."

► Trans World Airlines will link its disaster system directly with its North Atlantic route as an all-jet jet service beginning Jan. 3. Domestic all-jet service will be completed Dec. 3 on a Los Angeles-San Francisco-Chicago-New York segment. The following segment, service will be extended to London, Frankfurt, Paris, Milan and Rome.

► CAB Bureau of economic regulation has supported a proposed interchange agreement between Pan American World Airways and Delta Air Lines that would provide Atlanta and New Orleans with direct flights, direct connections with London and Paris via Washington and Philadelphia.

► Air France last week turned the operation of Air Afrique over to African nationals. About 400 Air France personnel were withdrawn from the Air Afrique sector to make the airline an independently operated African airline.

► Air France will begin direct service between Washington, D. C., and Paris next spring. Initially, the morning service will be operated three times weekly beginning Apr. 1 with Boeing 707-320 transporters.

► British Overseas Airways Corp. will increase the number of flights between Tel Aviv and London from two to four weekly beginning in March, 1968. De Havilland Comet transports will be used in the operation.

► Delta Air Lines has purchased two additional Douglas DC-8 transports for delivery in November, 1968, and May, 1969. Order will bring Delta's DC-8 fleet to a total of 16.

► Iberia Air Lines of Spain has started an all cargo service on its Palma de Mallorca-Barcelona-Frankfurt route. The daily schedule is being operated with an all-cargo Douglas DC-4 transport.

► Malabar Airlines stockholders have approved a plan to increase capital stock from 2 million to 3 million shares. The action provides a program to raise \$6 million in convertible debentures, proceeds of which will be applied to the purchase of four BAC 111 jet transports.

► National Airlines will offer more than 24,000 seats weekly during the winter season from New York's Idlewild airport and about 7,000 weekly on flights from Newark.

► Northwest Airlines has placed a \$37,345,000 order for one Boeing 707-320 and three 707-320 turboprop transports in being. Northwest's total jet fleet is 23 aircraft. The purchase will require an additional financing on the part of the airline.

► Syrian Airlines and Iraqi Airways will be merged into a single company, under an agreement signed late last month by the two companies in Damascus.

► Southern Airways carried more passengers in October than in any month in its history. Number of passengers carried increased 23.6% in October, compared with the same period last year.

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The American Airlines fan-jet story.

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All of our Astrojets are fan-jets. [We have 64 of these planes—41 more than anyone else in the business.]

But if you're on any other jet, take a look.

Big Lift Completed Without Major Hitch

By Cecil Browder

Chateauroux Air Base, France—Operation Big Lift, involving a total of 205 Military Air Transport Service transport and personnel aircraft plus three tactical Air Command fighter squadrons and support planes in the largest coordinated, long-range U.S. airborne exercise attempted thus far, was kicked off at 05 hr. 5 min. without a major maintenance hitch.

MATS maintenance officials with the 1612d Air Transport Wing camped just here, a MATS control unit for the operation, and frankly that they were "amazed" at the paucity of work orders generated by the 235 reserve exercise.

The MATS commitment involved 23 Boeing C-119 transport aircraft, each of which made two round-trip flights over the 5,000-mile route between a scene of Texas airfields and Rhein-Main Air Base near Frankfurt, Germany. 38 C-119s, 98 Douglas C-124s, 38 C-119s, 58 Douglas C-124s, and 38 C-119s, plus 18 Douglas C-119 transport aircraft which were not required to fly, plus the 1612d Air Transport Wing camped just here, a MATS control unit for the operation, and frankly that they were "amazed" at the paucity of work orders generated by the 235 reserve exercise.

TAC units included two squadrons of North American F-100 day fighters, one squadron of Macch 2, all-weather Republic F-105s plus six Douglas RB-66 and eight McDonnell RF-101 reconnaissance aircraft and 48 Lockheed C-

expected in Big Lift planning.

- Prattville, Scotland, which received C-119s in their re-banded flights and later "received" them after they had deposited their troops on the European continent—replacement of several components.

- Munich, Germany, which received 31 C-119s as major maintenance.
- Hannover, Germany, receiving C-124s and C-119s—most of C-124s and C-119s.

- Tampara, Spain, a C-119 "recovery" base—two engine changes, two propeller replacements and one broken fuel tank.
- Chateauroux, France—no C-119 engine change.

- Chateauroux, France—A C-119 propeller change.
- Puckburgh, France—A C-119 propeller change.

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- Puckburgh, France—A C-119 propeller change.

Base maintenance personnel were responsible during the week for all such repair, shop maintenance work and other back-log tasks required. Their response might be called that of the MATS low maintenance team.

A Chateauroux base maintenance officer told AVIATION WEEK & SPACE TECHNOLOGY last week that he was "really impressed" at the condition of the aircraft when they came in here. They were clean and in real good shape.

After placing their shops in a 24 hr. 5-min. busy ready in kind in continuing, Chateauroux maintenance officers and the work load actually fell below the mark, standing far from a combination of the good condition of the MATS Big Lift aircraft and a built-in safety margin in the amount of aircraft traffic flow into the base.

Of the 71 aircraft arriving here, base maintenance personnel were called upon to service only 18. Three C-119s and 18 C-124s, the standard shop workload for work orders to replace C-119 parts—tasks which required a total of approximately 10 hr. work and a substantial change to an aircraft.

The C-119s, carrying in excess of 75 troops each plus their duffel bags, made the Texas-to-Rhein-Main flight in an average time of 30 hr. 35 min.

C-119s, each with 33 troops aboard, followed one route to the north and one to the south. Block-to-block routes in the aircraft along the northern route from a number of southern and northwestern bases included 6 hr. 15 min. to Hurns, North Carolina, 5 hr. 58 min. from Hurns to Frankfurt, Germany, and 5 hr. 25 min. on to the offload point.

The southern route involved a 6 hr. 15 min. flight to McGuire AFB, N.J., another 5 hr. 10 min. to Lajes in the Azores and a final 7 hr. 45 min. to the offload point.

The C-124s, each with 50 troops aboard and the slowest aircraft participating in the lift, flew in 11 hr. 35 min. and, by way of the northern route to Bonn, Germany, made a 11 hr. 10 min. to Munchen, and a final 2 hr. 55 min. to the offload point. On their southern route, the C-124s required 9 hr. 10 min. to reach Keesler Air Base, Memphis, another 5 hr. 45 min. to Lajes, and then a final 9 hr. to the offload point. A crew change was made in Lajes.

On their northern leg, the C-119s, carrying 60 troops each, flew the initial leg from Chateauroux AFB, Tex. to the scene in an average block-to-block time of 5 hr. 20 min., and the final leg to Rhein-Main in 9 hr. 15 min. C-119s flying the southern route averaged 11 hr. 34 min. to Lajes and another 6 hr. 30 min. to Rhein-Main.

The C-119s reached Genevieve Bay from Texas in an average of 9 hr. 10 min., with the flight on to the offload point requiring another 9 hr. 45 min. Over the southern route, aircraft loaded Desert AFB, Del., in 5 hr. 25 min. Lajes in another 5 hr. 45 min., and the offload point in a final 9 hr. 15 min.

Approximately 90% of MATS' total lift capability and 50% of its aircraft strength—315 engines—requiring a total of 2,999 flight personnel—were involved in the operation.

Big Lift Shows Jet Advantages

Washington—With the 13,275 troops of the Army's 2nd Armored Div in Europe in Exercise Big Lift (AW Oct. 25, p. 24) demonstrated that jet equipment can deliver initial troops, ready to fight while planes poured in slowly, especially on terrible cargo transports, exhausted the men during long flights and requiring stops for maintenance and refueling in 44 hr. 5 min. with a 100% safety factor, also demonstrated that the orders could be delivered faster than the pre-positioned heavy equipment could be loaded and driven over.

The C-119 jet transport flew from Texas to the base in Europe in 30 hr. 45 min. or 41 hr. 30 min., depending on which side of the North Atlantic high pressure was over the base. The C-124s, which took 33 hr. 35 min. to make the trip, with one or two fuel stops en route. The men who traveled in these unaccompanied aircraft were noticeably less fat physically and psychologically when they debarked.

Heavy equipment sufficient to two divisions is kept in Europe. In this instance, the troops proceeded to their assigned equipment in 30 min. after they debarked. Jet equipment is not required to be loaded over the aircraft, and thus proceeding immediately to their deployment area. In the future, equipment will be placed near logistics to speed the departure from the storage area.

In its effort to transport the Air Force said that the 202 transport aircraft can place their missions without "hitching." The means that there was no mishap of an individual aircraft in accident or other equipment or injury to personnel attributable to the flight.

Significance of the record is highlighted by the operating conditions. Most of the flights were made into fields other than those used regularly by planes of the Military Air Transport Service. These fields are called Despatch Operating Bases (DOBs), and are commonly kept as a standby status with minimum crew without the need for a full complement of personnel.

In the case of the flights of the Douglas C-124 Globemasters, Lockheed C-130 Hercules, Douglas C-119 Liftmasters, Boeing C-130 Globemasters and Douglas C-119 Globemasters had never landed in the fields before.

In addition, the unusual weather in Europe was poor during the period in which the troops were loaded. American land landings had to be made with different methods than those used in the past, and by the pilots.

The total number of hours involved in the lift, in Texas, in Europe and in Europe was 14. Generally speaking the C-124 loaded first; the C-119s, second, and the C-119s, third. The C-119s, which were the last to be loaded, were the last to be loaded.

A secondary factor was the time to develop another and last shipping operation than those conducted in the lift of 12,000 Marine troops to Guatemala Bay, Cuba, during the Cuban missile crisis in October, 1962.

The final 6 hr. 5 min. flight segment, the time the first aircraft left Bergingen AFB, Tex., and the final transport of the Big Lift landed down onto the Rhein-Main, corresponds almost exactly to aircraft production. The overall flight time for the entire operation included a 9 hr. cushion to provide for the contingencies of weather and equipment use.

Gen. Joe W. Kelly, MATS commander, said that the lift operation could be repeated in 30 hr. for the lift of a single division under emergency conditions, provided the aircraft were available, and to 45 hr. on a permanent basis of the political atmosphere.

Approximately 90% of MATS' total lift capability and 50% of its aircraft strength—315 engines—requiring a total of 2,999 flight personnel—were involved in the operation.

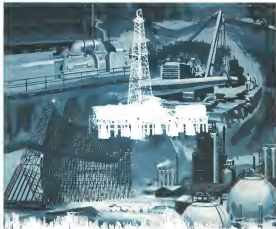
Gen. Kelly also stated that the lift operation could be repeated in 30 hr. for the lift of a single division under emergency conditions, provided the aircraft were available, and to 45 hr. on a permanent basis of the political atmosphere.

Approximately 90% of MATS' total lift capability and 50% of its aircraft strength—315 engines—requiring a total of 2,999 flight personnel—were involved in the operation.



SST Concepts Indicated in Models

Varying design concepts for the supersonic transport are evident in comparison of the Boeing Model 733 (lower right) with the NASA SCAT 35 (middle) and SCAT 37. Boeing model shows two engines pylon-fairing and two beneath the fuselage. Boeing company also does research on such problems as their engines in the air and on the ground. The SCAT 35 is a delta-wing aircraft, and the SCAT 37 is a delta-wing aircraft.



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many intricate and highly diverse engineering and construction projects successfully undertaken by Brown & Root with an enviable degree of on-schedule performance. Versatility is more than just the capacity to cope with a wide variety of civil, industrial, and marine problems. It is also the ability to deal harmoniously and efficiently with all aspects of a single undertaking to the end that it may be accomplished in the most economic and rapid manner possible.

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been might have prevailed over several of the buses at any given time.

For the time of the visit, however, the weather was unusually kind. Only 20 MATS aircraft representing approximately 85% of the total system involved had to be diverted. Of these, 15 were sent to alternate fields because of weather at their original destinations, five because of adverse winds over the North Atlantic.

As opposed to this, Rhein Main first-class citizens felt the field during a several October will be below the 100 ft ceiling and 1-m visibility minimum for the C-130 at least 10% of the time. During Big Left, a total of seven aircraft were diverted because of weather, while another 17 were accepted.

First Contingent

First contingent of C-130s landing at Rhein Main were needed out again within 3 hr on flights back to the U.S. in order to meet the requirement that all 25 of this type aircraft involved make two trips to Europe with a full contingent of troops aboard.

To accelerate the move, a C-130 after landing turned directly to one of three stations running from inflated "bladder tires" with capacity of four complete legs, each capable of holding 50,000 gal of fuel.

Troops were berthed before offloading, as was the crew, by a MATS maintenance officer, while ground personnel prepared the aircraft for fueling. Crews and troops were then debarked and the 16-cars, including passenger buses, with the "bladder tires" ranging out approximately 100 gal of fuel per minute in support of the maximum of 100 gal per min. capability of the standard tanker trucks assigned to Rhein Main.

Checkout Continued

The aircraft was then tested in an other map station, where the ground crew continued its checkout and performed any necessary maintenance. Flight over the water field is reported to the aircraft 2 hr before departure time.

To keep the flow moving, a total of 11 Big Left crews were positioned at Rhein Main, handling the first 11 return flights, while the original crews obtained the required 15-hr ground rest before leaving for the U.S. again.

Beginning with the 14th aircraft returning to the U.S., MATS began ferrying approximately 1,800 troops to Forbes AFB, Kan. The returning troops represented a contingent flown to Europe three months earlier in one of USAF's "Long Term" airlift exercises that have been under way on a regular basis since January, 1963.

Big Left, at risk, substantially repeat



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Taber TELEDYNE® Pressure Transducers are assisting TRW's Space Technology Laboratories in its development of a dependable, efficient thrusterless descent engine for LEM, Lunar Excursion Module of NASA's Project Apollo.

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Type 221 Developed as Concorde Research Tool

Newly British rock is also being heavily awarded with the Anglo-French *Concerts symphoniques* (sponsored by the British Trade 221), ordered from Priority Depts 3. Consider a judiciously different. Major modifications include up-to-date wing (AW Aug 6, 1962, p. 28). Type 221 is 6 ft. longer than Priority Depts 3 and has outboard engines for Kollsman-Rosen. *Radio* 221 engines. Note wing leading edge extending almost to tip of nose section as reflect plates (herv) New wing (left) is similar to that which will be used on the Canadian. Nose bridge above air intake for Avon propellers. Elevator on trailing edge tip on two sets. Air intake on top shows rounder. Note of air intake on top of wing. Tail will have horizontal stabilizer. British aircraft design will be completed by Royal Aircraft Establishment, Farnborough and Farnborough. First flight is scheduled early next year.



from pelorus ring to spacecraft guidance

in 200 B.C. when Hannibal was recalled from Italy to defend Carthage against Scipio's legions: an alleged pirate named Pelorus served as his navigator. His name now graces the Pelorus Ring, an instrument for sailors, seafarers and celestial astronomers.

landing one's bearings with a Pelorus is relatively simple, but establishing a fix in space is a complex problem. Guidance errors multiplied by the speed of spacecraft also cause complex problems, and are solved in milliseconds by an AC inertial guidance system. AC is presently working on the inertial guidance system for the Apollo Command Module and proceeding rapidly on the application of inertial techniques for other planned deep space vehicles. In addition to this program AC has been selected to provide the guidance for the ITAN (Interplanetary Transfer and Navigation) and REGULUS missiles. AC capabilities also extend beyond these programs, an AC pop-up computer, intended for

ment for S&D B-52s and initial components for the Navy P&C ARTS module.

Being selected for these programs is indicative of AC's accomplishments in all fields of guidance and navigation. See how AC's advanced thinking, full research and development capability, enhanced scientific staff and complete production facilities can fit into your space program. Contact Director of Sales, AC Sperry Plug Division, General Motors, Milwaukee, Wisconsin.



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AVIONICS

TSQ-47 Traffic System Undergoes Test

By Philip J. Kloss

FLORIDA, Fla.—Complete tactical test targets, traffic control, air-to-air tracking and communications facilities, which can be transported in three C-130s and placed in operation within a matter of several hours to convert an undeveloped landing strip into a high-capacity military airfield, are now undergoing initial flight tests here by the Air Force.

USAF's new AN/TSQ-47 system, set up here at a small Army airfield south of Boston, is the first of three scheduled to be delivered by the end of the year by Radio Corp. of America's Aerospace Systems Div., Burlington, Mass.

The AN/TSQ-47, sometimes referred to as "Instant Elkonite," is expected to be able to handle 24 aircraft in the air and as many as 24 on the ground.

The AN/TSQ-47 consists of the following major subsystems, each packaged in a lat which is designed to fit into profiles made in the C-130 cargo bay using equipment.

•AN/TPS-31 surveillance radar, built by RCA's Mobile and Surface Radar Div., provides two-dimensional coverage at distances up to 80 or 275 mi. at altitudes of the operator and altitudes up to 45,000 ft. The TPS-31 weighs 6,000 lb., including antenna.

•AN/TRN-17 Tropic navigation station, built by International Telephone & Telegraph Corp., is a ground-to-airportable facility weighing 6,000 lb., including antenna.

•AN/TPN-16 precision approach radar, a modified version of the TPN-8,

Essentially the three prototype systems are expected to go to the user command, Air Force Communications Server (AFCS) which maintains airborne squadrons at Tinker AFB, Okla., in France and the Philippines. However, the second system set will go to Eglin AFB, Fla., for category I capabilities tests and training purposes.

The three systems were built under a \$31.5 million contract from AF Electronics Systems Div., but cost is expected to drop to around \$2 million per system in one subsequent development contract for the first of the three TSQ-47s was awarded in the summer of 1962, followed shortly by the award for two additional units.

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•AN/TPN-16 precision approach radar, a modified version of the TPN-8,

both built by Collins. The equipment weighs 4,530 lb., including both antennas.

•AN/TSW-5 radar approach and traffic control center (Rapee), built by RCA's Aerospace Systems Div., weighs 11,000 lb.

•AN/TSW-6 control tower for active runway and VFR approach operations, with an associated van providing UHF, VHF and HF radio communications for ground-air service, also was supplied by RCA's Aerospace Systems Div. The control tower weighs 5,000 lb. and the van, ground-air communications, van weighs 3,600 lb.

•AN/TSQ-21 communications van, for point-to-point long range communications, contains HF radio for voice and teletype/telex service. It was supplied by Ailes Electronics, recently acquired by Litter Industries' Radcom Div.

In transport configuration, the TSQ-47 van, less its separate antennas, weighs 3,200 lb.

The TSQ-47 is designed to be installed, set up, operated and maintained on an around-the-clock operation basis with a complement of 18 operators and two officers. This includes one traffic controller in the Rapee, three in the VFR control tower and five operators in the TSQ-21 communications van per shift for full operations, or a total of 17.

The system is designed to permit



USAF's AN/TSQ-47 transportable airfield traffic system now undergoing test includes radar approach and traffic control center (left) with four large CRT-type displays and two precision approach radar displays within bay shelter shown (right). During transit in C-130s, sites of center (left) shown. Note small shelter at rear (right) which contains assigned communications equipment.

The other day, at Republic Aviation's Life Science Labs, where we are running the life-support and mobility tests on the Apollo Space Suit, somebody asked the guy in the suit how the tests are going, and he said:



CONTROL TOWER CAB, operating on 4 ft. high jacks (left), provides room for three controllers, plus full complement of UHF, VHF and HF communication equipment. Exterior view shows cabin windows, which fold up to protect viewing windows for transport of tests.



wide separation of individual vans. For example, the TPS-15 surveillance radar can be situated atop a hill up to 15 mi. away from the Rapcon for maximum visibility and operated remotely from the Rapcon. Radar data is transmitted via a high-band microwave link. Similarly, the TPN-14 approach radar can be located up to 5 mi. away, with its built-in microwave link. When either radar is used within 1,000 ft. of the Rapcon, it also is connected by coaxial cable to provide a backup link.

The TAN-17 Tacan station can also be sited up to 1 mi. away for optimum performance. Intercommunications between the individual vans is provided both by land-line telephone and by a Micro-Orbital built Rapcon-transmission disseminator VHF radio link. Six mobile Rapcon units, operating from 24 v.d.c. are available for use by each truck or at other remote sites. The search and approach radars and the Tacan station are designed for an attended operation.

Electric power for the TQD-17 is supplied by 14 small turbine-powered generators, supplied by the Garrett Corp., which burn distilled aviation fuel. The generators are rated at 20 kw. and produce three-phase 400 cps, power, rather than 60-cps power. The 400 cps power was selected to save weight and size in all its source equipment used throughout the system and to permit maximum use of lightweight, compact antenna UHF, VHF and HF communication equipment for ground-based use. The only exception is the TAN-17 Tacan station, which is of an earlier vintage and designed for 60-cps operation. A 10.5 kw. 60 cps frequency converter changes the 400-cps power to 60 cps for the facility.

One of the more important elements

of the TQD-17 is the TSW-5 Rapcon which contains four 20-in. dia. PPI type radar scopes plus two approach radar displays, with associated automatic tracking units, and positions for non-traffic controllers in a hut which faces the outside scene far too small to hold even a fraction of this equipment.

The hut has telescoping sides which slide out for operation. For transporting, where on the radar console permits them to be shifted to the center of the hut so the sides can be telescoped in and in transport configuration, the hut measures 180 in. x 96 in. wide and 90 in. high.

When set up for operation, the width increases to 174 in., providing 177 sq. ft. of floor area.

The facility has provision for automatic radar target tracking which enables a controller to assign and display identification symbols for up to 10 aircraft at one time. Each symbol is assigned to an aircraft follows its radar blip on all four PPI scopes to facilitate handoffs from one controller to another.

While all four PPI scopes, built by Adcock Corp., can be oriented either in a horizontal or vertical position, normally only one is used in the horizontal position for the two armed and two disarmed controllers. Overhead is an optical projector which, at the option of the controller, can superimpose a map of the surrounding terrain on reception side on the radar screen. Similar provision is made for the search supervisor's scope. The projection can translocate made by a Polaroid camera. A lot is provided, including camera, so that the required maps can be made up on the spot.

The two precision approach displays use 10-in. dia. cathode ray tubes with

the familiar azimuth-elevation sight display. The elevation display contains a line which shows the lowest safe aircraft altitude as well as the desired glide slope.

The small communication van adjoining the Rapcon contains seven UHF transmitters (receive units), six VHF units and one single sideband HF set. All are controlled from the display of any radar, providing it is not in use. Antenna coupler and filter units enable simultaneous use of all VHF or UHF sets from a common antenna atop the Rapcon communication van.

The TSW-5 control room also demonstrates that a considerable operational capability can be squeezed into a small volume. At first glance it looks like a conventional Federal Aviation Agency tower where power was started, since it works only 4 ft. above the ground on four metal jacks. A metal mesh catwalk surrounds the tower. When the tower is disassembled for transport, the mesh is used to protect its sloping windows. In transport configuration, the tower must carry 146 x 24 x 90 in.

The tower has space for three operators, one controlling arriving and departing aircraft, a second controlling ground traffic and a third who operates flight progress strips and supplements the efforts of the other two. The facility provides five UHF, four VHF and one HF 558 mhz channels for the controllers with the equipment mounted inside the tower during a common antenna atop the structure.

The tower has a VHF direction finder, the AN/GRD-11 made by Servo Corp. of America. Towers also contains its own wind velocity-direction sensor and barometric pressure sensor. Tower operators have a remote control which enables them to select the frequency at



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AN/TPS-35 SURVEILLANCE RADAR provides coverage out to 275 mi range and altitudes up to 45,000 ft. spend small jet aircraft. One-megawatt radar has subject provisions.

which the Ticon station is operating.

The TPS-35 surveillance radar is a modified version of the AN/TPS-1 developed originally for the Marine Corps. One of the modifications is to allow new jet jets provisions to make the jet more suitable to cruise counter evasion.

Circular polarization is provided to minimize precipitation clutter and a frequency modulation-type of moving target indicator channels provide true range effects. The radar operates in L-band (1,250-1,350 mc), has a peak power of one megawatt and includes provisions for IFT/RFI radar test-pulse beacon operation. A parametric modulator increases radar sensitivity so much, it is as small jet aircraft out to ranges of 275 mi and at altitudes to 45,000 ft. Other jet operating characteristics include:

- Antenna gain: 27 db
- Beam width: 3.7 deg in azimuth, with concentrated shape beam in elevation
- Beam area: Adjustable between 0 and 15 sq mi

The TPS-14 approach radar built by Gilfillan, an adaptation of its TPS-5, operates at X-band (9,000-9,600 mc) with a peak power of 200 kw. The first which houses the TPS-14 also contains UHF and VHF communications and an approach's position with an A/EI display to provide emergency back-up for the Radar operation. The approach and elevation antennas can be rotated in azimuth to permit the TPS-14 to provide approach guidance for more than one runway, if desired. The elevation (gyro-stabilized) antenna has a vertical beam width of 1.1 deg and a horizontal width of 3.5 deg. The approach (azimuth) antenna has a horizontal beam width of 1.5 deg and a vertical dimension of 3.5 deg, azimuth-squared to 30 deg.

The TPS-14 enables the Radar operator to selectively select linear or circular polarization for either antenna and to change pulse width from 0.2 to 0.6 microseconds for optimum sensitivity. Monopulse operation is used in the vertical position to provide higher resolution in the critical dimension. Operator also has choice of two logarithmic range scales, 5 and 10 mi, or a 20 mi linear range for his display console.

The TACAN 17 Ticon station, with its three-armed antenna atop a telescoping mast, was provided by USAF to government furnished equipment from its standard units. The look better, they complete transmission with the back-up unit operated continuously so that if one antenna is switched into service, the other unit should follow.

The TSC-23 point to point command radio substation is the only element of the TSC-47 which was not at Ft. Davis. During that airport's recent visit.

It was undergoing acceptance tests on Long Island, N. Y. The TSC-23 contains three high frequency radio equipments. Each, covering the 2-30 mc band, uses separate antennas: local antennas for reception and transmission. The other two each use a large, high-gain, log-periodic antenna both for transmission and reception.



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Who's first in the fish business?



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Following the Mark 18, Westinghouse went on to design and build the Mark 28, 29, 32 and 45 torpedoes. Later, the Mark 45 ASROC, is a high-speed ASROC weapon, 30 feet long, weighing over a ton,

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through use of antenna's capsule capsule and operate in the 4-18 cm band. The antenna, built by Cramer Associates, is 100 ft high and 170 ft long. Combined weight of the two log periodic antennas is 3,000 lb.

The RF angle selected transmission provides 1 kw output power. Both transmitters and receivers can be tuned automatically to preselected frequencies or can be manually tuned as far as necessary. Each of the three RF channels provides four 1.5-c subchannels with two of these subchannels multiplexed on the upper subband, two on the lower, to give 12 subchannels complex telephony signals. On-line cryptographic facilities are selected.

RCA's project manager on the TSQ-47, Ralph Davis, says that when the subchannels were delivered by the various subcontractors to Ft. Detrick and interconnected in the first test, "health monitoring worked right off the bat." Considering the complexity of the unique system, this was no small accomplishment. RCA attributes this in part to the fact that detailed design studies sponsored by the Air Force had provided the grand of the hardware fabrication contract and to its decision to use proven components and hardware wherever possible (AVW Mar 5 1982, p. 39).

Early in 1980, Air Force awarded paid task contracts to a number of companies covering various elements of the system. For example, RCA was assigned to study the design requirements for the search radar. Elsewhere this includes Hughes, Collins Radio the communications requirements, Garrett the power and air-conditioning needs, HRL Singer the human engineering aspects. Later on, Pan Electric was awarded main transmitter and General Dynamics the antenna deployment. Out of these studies, for example, came the idea of using existing airborne communications nets which were smaller and lighter than any available system designed for use in ground stations.

Befitting some of these units were built for commercial aircraft use and not designed to withstand military hostilities, contractors, it was necessary to provide an air-conditioned environment in the Raytheon and point-to-point communications station. However, this proved no major problem since electric-powered air conditioning units also was needed to provide a comfortable environment for human operators with in the cramped station.

The TSQ-47 program was carried out under the direction of the Electronic Systems Division of the Air Force project office, headed by Col. Martin Peterson. Benjamin F. Corcoran, Jr., chief of the SDC's technical support division, was the technical manager on the project.

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AFGRL's U-2, named the Sant, is shown above, top, in a hangar at Hanscom Field with instrument pod on. In the close-up of the instrument pod (above, lower) visible equipment includes (1) 70mm camera for photographing clouds and terrain, (2) radio for ground tracker, (3) radio amplifier, (4) wind computer, (5) ocean surface, (6) wind cone probe indicator and (7) infrared non-channel indicator. Aircraft will soon be equipped with a new infrared hypervisor for measuring humidity in the upper atmosphere.



FIVE FLYING LABORATORIES, based by at Hanscom, Massachusetts, are a KC-135 and

Hanscom Field, carry AFGRL scientific and related research vehicles. In left foreground is a U-2 instrumented for meteorological studies, Acropolis aircraft, a C-130A for cloud physics studies, a KC-135 being equipped for gravity studies, and the optical physics C-130A.

AF Research

By Michael L. Yaffe

Bolton, Mass.—Air Force Cambridge Research Laboratory instrumented aircraft, making extensive radar measure-ments above Cape Canaveral, have arrived in an what appear to be the case of the rangeable noise in the radio interference system used to track missiles and spacecraft.

From data gathered by C-130A and U-2 aircraft, AFGRL and Technical Operations Research scientists have joined together a picture showing that even extremely small concentrations of air molecules (150 parts per million) can cause undesirable noise in the MISTRAM radar interference tracking system used at Cape Canaveral.

AFGRL is now expanding its work

in this area. The first step will be a comprehensive measurement of the cloud and moisture characteristics around the Atlantic Missile Range tracking system.

Eventually, AFGRL scientists hope to eliminate tracking errors or noise through redesign of the radio tracking system, or by developing a method of measuring the amount of moisture an aircraft has to fly to enable them to predict detection they can expect.

The flights, under the direction of AFGRL's Meteorological Laboratory, are part of a growing program of pre-flight research studies being flown by AFGRL's airborne laboratories.

AFGRL now has five highly instrumented research aircraft operating out of Langley G. Hanscom Field now

includes one U-2, two C-130As and two KC-135s. Another C-130A is now at the U. S. Naval Air Station at Quonset Point, R. I., being instrumented for ocean and short-range gravity studies. It is expected to be ready for detection flights at Edwards AFB by the end of the year.

AFGRL scientists also fly missions on balloons, satellites, rockets and Air Force aircraft such as F-100 operating out of Wright Patterson AFB.

The five research aircraft now at Hanscom Field are currently instrumented for studies in four different atmospheric areas. Basically, as defined by AFGRL, these include terrestrial sciences, optical physics, meteorological research and ionospheric physics.

AFGRL's U-2, which carries the

work and more of Leiber Center's for radar detection called the Sant, is equipped principally for meteorological research. In the measurable pod directly behind the cockpit there are these instruments:

- Pressure altitude transducer,
- Infrared non-channel radiometer for measuring cloud top temperatures in the 5-15 micron range,
- Fast-response free air temperature probes,
- True airspeed transducer,
- Indicated airspeed transducer,
- Electric field meter,
- Wind computer indicator,
- An ocean meter,
- 70 mm and 16 mm cameras for photographing clouds and terrain.

(Continued on p. 12)



AIRBORNE LABORATORY is carried by the Sant, a KC-135, for studies of the D, E and F regions of the atmosphere. On top of the KC-135 are (A) the five blade antennas used in the high-frequency radio wave propagation studies and (B) the long antenna for very low frequency research.



INSIDE THE KC-135 instrumented laboratory, instruments (left, above) include (A) free-throat pitot-static probe, (B) spectrophotometer and (C) infrared spectrometer. Among equipment in second window view (right) are a motion camera and plasma ray spectrometer.



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The aircraft soon will have a new infrared hygrometer for measuring humidity in the water stratosphere.

The U-2 is engaged in research on stratospheric circulations in support of AFRL's North American Ozonewatch Network, and also in cloud physics work.

In order to measure the amount of atmospheric ozone, a strand of balloons equipped with instruments are launched every Wednesday at 1200 hr from a well base from the 11 streams in the North American Circumnavigation Network.

Open Measurement

The Sarc, which flies out of Edwards AFB and Patrick AFB as well as out of Henslow Field, supplements the vertical balloon sampling by measuring ozone between the network stations. It measures ozone above and below the tropopause and in frontal systems, and also maps the ozone cross-section of the jet stream.

The US also is taking part in the relative index measurements at the Atlantic Marine Range by, among other things, photographing cloud cover during sunrise and sunset launches. As part of AFCRL's work on the National Severe Storms Project, the U-2 has above cloudcasts, taking pictures and measuring electrical fields. Other measurements are being made by a F-100, flying high through the center of the storm, and by a C-130A, flying about the edge of the storm.

Earlier this year, in connection with the continuing study of air flow over mountains, the AFOSL constructed a smooth updraft at 63,000 ft., in the lee of the High Sierra that earned it a rating of number 10 (63,000 ft.

The S&B also flies several missions each year to calibrate equipment and check out new infrared instruments. Measurements of terrestrial radiances made with the radiometer in the U.S., for example, are being used by AFGL scientists to help interpret infrared measurements from astronomical satellites by providing a reference point against which the calibration of the satellite radiometers can be checked.

Like the *Sant*, Cunningham's Rough Riders (one of APERL's two C-130 flying laboratories, which is named after Dr. Robert M. Cunningham, head of the Meteorological Laboratory's Cloud Physics Branch) is specially outfitted for cloud physics research.

It takes part in interactive index measurements at Cape Canaveral, several storm studies, mesoscale meteorological research on jet streams, hurricanes, and



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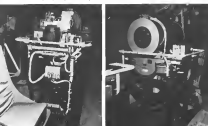
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KC-135 TESTBED, now being equipped for airborne gravity measurements, was also used as the Fish-Bowl carrier test area last summer. From along the top of the bridge were the instruments used to observe the high altitude effects of nuclear explosions and have to place in the gravity research program now getting under way.



INTERIOR OF THE FLYING GRAVITY laboratory shows color management (above) looking forward. The two gravity meters (below) carried by the aircraft are mounted on stabilized platforms to keep them in true vertical position at all times. The one on the left is the Ge Gravitometer gravity meter, that on the right is the Advanced Gravity meter. Both were originally designed for shipboard use and have been modified for airborne work.



less and maintain her nose, cloud and fog modification, atmospheric clarity measurements and various other studies on the broad area of cloud dynamics.

Primary operational environment of the aircraft is the troposphere, up to a maximum altitude of 75,000 feet. Eventually, it serves:

- Two probes to sample liquid water content.
- Wetness thermometer that indicates true air temperature.
- Rotational thermometer for measuring total air temperature which takes into account the temperature factor resulting from the motion of the aircraft.
- Long side probe that measures the liquid water contained in supercooled clouds.
- Air sampling ducts.
- Aerograph probe for measuring temperature and humidity.
- Four electric field measuring devices, which allow to measure and the various time decreasing the direction and polarity of electric fields in the vertical, horizontal and longitudinal area, and to measure the electric field charges on the aircraft itself.

The aircraft also carries three cameras to monitor camera for sampling terrain and photographing cloud configurations, and four 16 mm cameras used for time lapse coverage. The time-lapse cameras are pulsed to record one frame every three seconds.

The other C-130A at Haneson Field is assigned to the Optical Physics Laboratory. The aircraft is instrumented to measure parameters that affect atmospheric visibility as part of AFPCAL's work on improving photo-astrometric source capabilities, image restoration and plate observation. In addition to the C-130A, which will have an operational ceiling of 35,000 ft., is another in AFPCAL's Optical Physics Laboratory, with one instrumented balloons, rockets and other a satellite to make their visibility measurements.

Among the particular parameters the optical physicists plan to investigate is detail in the scattering of light by atmospheric molecules and particles, the brightness spectral and spatial distribution of visible radiation and optical effects.

The special instruments that will be carried by the C-130A for its part in the atmospheric visibility program will include the following:

- Aerosol spectrometer probes extending as far as the aircraft is called as samples for the spectrometer, which will then determine the number and sizes of particles in the samples. From this the scientists hope to learn whether Raleigh scattering (that cannot be particles smaller than the wavelength of the light) or Mie scattering (that caused by particles approximately the same size

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*RADEM (Random Access Delta Modulation) principle diagram shown is the result of 2 years of independent Motorola research.



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CLOUD PHYSICS C-130A. Comanche's Rough Rider, carries a variety of entered sensors, including (A) liquid water content probe, (B) vortex barometer, (C) barometric densitometer, (D) wing site meter, (E) an sampling duct inlet and (F) outlet, (G) wing probe and (H) an electric field meter

155 to observe the "side" areas, the visible areas and beyond. They also plan to study the 50,000 ampere electrostatic current that runs from wall to wall in the stratosphere.

In order to determine the effect of latitude on the weather mode of propagation via magnetic ducts in the ionosphere, the scientists will fly the aircraft to the magnetic southern conjugate point of a transmitter located in New Hampshire. They will try to pick up and measure high frequency signals and VLF signals at 16.6 kilocycles and 100 kilocycles to determine if the weather mode of propagation via magnetic ducts also holds for radio waves at these frequencies.

They also plan to investigate the relationship between the ionosphere that exists at an altitude of 60 kilometers (thought to be caused by electrons coming from the Van Allen belts) and the ionospheric absorption of electromagnetic energy. To do this, they will fly along selected flight paths making continuous recordings of ionospheric values from their airborne transmitter.

Gravity Research

The other KC-115 flying laboratory is assigned to the Terrestrial Sciences Laboratory, where it will be used to continue the airborne gravity research program that was carried out last year in a C-130A. In addition to making gravity measurements over the free world, the KC-115 will serve as a certified facility for developing new gravity instrumentation and measurement techniques.

From these airborne gravity research results, AFPC scientists hope to be

able to determine independently the true shape of the earth, according to Dr. David G. Thompson, project scientist. For these areas of the world, such as Russia, not open to the KC-115, they hope to arrive at valid figures through extrapolation of available measurements. Satellite gravity measurement programs, in their present state of development, are not able to provide a precise definition of the earth's gravity, Dr. Thompson said.

Important Objectives

An important objective of this program, of course, is the collection of precise gravity measurements for use in ballistic missile guidance systems. From an earlier study, says AFPCAL, it was determined that the gravitational disturbances along the trajectory of a missile could have a significant effect on the point of impact of the warhead.

The KC-115 flying gravity laboratory is well being equipped at Hanscom Field. Shortly, when this is finished, it will go to Edwards AFB for flight testing. The first language flights, which are expected to include a flight around the equator, are now programmed for mid-1968.

Head of the instrumentation group aboard the KC-115 is the two airborne gravimeters. One is a La Crosse Rensselaer gravity meter which is mounted on a precision stabilized platform that maintains the unit in a true vertical position at all times. This unit will measure changes in the vertical component of the gravity field as small as one part in one million.

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growth water. This is also mounted on a precision stabilized platform, and has the same capabilities as the La Crosse Beamless meter. After looking at the available instrumentation, AFCEIL scientists decided that these two units, which were originally designed for use aboard ships, were the only ones capable of being modified for airborne application.

The aircraft will also carry a modified Airborne Profile Recorder for measuring the height of the aircraft above the ground and for recording changes in altitude. AFCEIL scientists will then use this information to find the true altitude of the aircraft above mean sea level and to eliminate the effects of disturbing vertical aircraft accelerations from the growth readings.

A photo radar, which will work continuously with the two gravity meters for the duration of the flight, will photographically record at intervals of ten seconds a number of navigational parameters such as ground speed, heading, drift angle, latitude and longitude.

Aerospace Companies Report on Salaries

Washington—Following is a list of aerospace industry executives and officers with 1962 salaries above \$10,000, and their stockholdings, as they were reported to the Securities and Exchange Commission.

AMERICAN MACHINE & FOUNDRY CO. NEW BRITAIN, CT President & active (retired October 1962), president of Peter & Starfield Inc., \$15,151 salary, 153,127 shares of common stock, \$14,450 dividends; G. L. Beggs, president (from Jan 1 to Aug 16, 1962), chairman of the board and chief executive officer (as of Aug 16, 1962), \$10,368 salary, 1,608 shares of common stock, \$23,160 dividends; O. S. Cox, director (retired 1962), 208 shares of common stock, F. P. Downey, vice president (from Jan 1 to Aug 16, 1962), president not president (as of Aug 16, 1962), director \$18,175 salary, 21,268 shares of common stock, \$69,900 dividends; R. G. Davis, executive vice president (from Jan 1 to Aug 16, 1962), president (as of Aug 16, 1962), director \$15,576 salary, 16,994 shares of common stock, \$17,650 dividends; G. S. Mat, vice president in charge of process director, \$11,655 salary, 1,821 shares of common stock, \$4,280 dividends; G. S. Tink, general counsel, director, \$26,126 salary, 16,265 shares of common stock, D. S. Middlebrook, financial vice president and treasurer, \$17,451 salary, 19,126 shares of common stock, S. J. Chaberski, director, 114 shares of common stock, H. P. Parsons, director, 24,160 shares of common stock, director and treasurer (inactive) of a test building, 1,264 shares of common stock, 2,159 shares of common stock held

STL NEW PROPULSION OPPORTUNITIES In Southern California

TWA Space Technology Laboratories is now developing the elegant engine for the Apollo Lunar Lander Module (LLM), and alternate vapor engines for the Saturn space shuttle program. These programs, together with other research and development programs now under way at STL, contribute to provide many immediate openings in advanced propulsion technology.

Initial assignments will be at STL's new Space Technology Center in Redondo Beach, near Los Angeles International Airport, with opportunity for transfer to STL's multi-million dollar production facility now under construction in the San Gabriel Valley near Fontana, California.

Requirements include a degree in engineering or science with appropriate experience.

LIQUID ENGINE DESIGN, DEVELOPMENT AND TESTING

Experience in the design, development or testing of liquid propellant propulsion systems, rocket engines and systems, gas turbine engines, thrust chambers, injectors and thrust vector controls.

ROCKET ENGINE TEST STAND INSTRUMENTATION AND SIGNALS

Experience in the design, installation, operation or maintenance of liquid rocket engine test stand data acquisition (analog and digital) and control systems.

NEELANDS AND ANALYSIS

Experience in test facilities, hydrodynamics, gas dynamics, combustion analysis, instrumentation, and data processing and analysis.

For interview in your area in the near future, send NOW! Forward your resume to STL, Department 4000, 2000 Space Park, Department 4011, Gas Space Park, Redondo Beach, California 90747. This is an equal opportunity employer.

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BIGGEST SPACE CHAMBERS BUILT... BY PDM

PDM has designed and built two space environment simulation chambers for NASA's Goddard Space Flight Center at Greenbelt, Md.—the largest high vacuum chambers built and tested to date. Each is 33' 6" x 58' 6", has a fully removable head, a stainless steel shell and a 3/4 polished interior surface. One is shown here.

These almost identical twins were designed for ultimate 1 x 10⁻⁴ mm Hg operation. One is equipped for ultra-high vacuum and has been shakedown-tested below 1.4 x 10⁻⁴ mm Hg—a full decade better than specified. The other is planned for dynamic testing at lesser vacuums—but is suitable for future upgrading.

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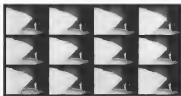
A cowboy is five miles south of a stream which flows due east. He is also five miles west and five miles north of his cabin. He wishes to water his horse at the stream and return home. What is the shortest distance he can travel and accomplish that?

—Continued

Concerned with long distance travel on the grounds from our Western Geophysical division working in connection with Project Mohole. Living techniques they've developed in petroleum exploration, they are currently surveying sites for the world's deepest well. At last report they were off the Hawaiian coast. For our Western news who think nothing of going from the Arctic Ocean to the Arctic on Hochstetler finding potential oil reserves, the Mohole find should prove refreshing.

ANSWER TO LAST WEEK'S PROBLEM: It will be found that where the river is relatively small only one set of numbers is possible. Dick is six, Tom is five, and Harry is four years old.

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preferred 3,301 shares of common stock, W. L. Harvey, vice president marketing division, 510,520 shares, 51,041 shares for conversion, 2,499 shares of common stock, J. N. Law, vice president engineering division, 517,512 shares, 51,041 shares for conversion, 9,049 shares of common stock, D. S. Wilkes, general counsel, director 17,447 shares of common stock, (Lap) has of 5111-600 paid to the two offices of D. S. Wilkes. All other figures for the fiscal year ending Sept. 30, 1962. All stock buy-backs ended as of Oct. 2, 1962.

GENERAL ELECTRIC CO.—F. J. Brady, vice president and group director, to July 31, 1962, executive vice president operations (from July 27, 1962) director (elected July 27, 1962), 515,712 shares, 579 shares of common stock, (Lap) is elected to stock but not paid in 1962 under incentive compensation plan, 14,911 shares of common stock, to 1,619 of these shares. Mr. Brady has a contingent interest, S. S. Cobb, director, 5170 shares of common stock, R. J. Conner, chairman of the board, director, 515,051 shares, 1,281 shares of common stock, (Lap) is elected to stock but not paid in 1962 under incentive compensation plan, 55,513 shares of common stock, to 11,119 of these shares. Mr. Conner has a contingent interest, C. D. Dick, director, 17,400 shares of common stock, E. D. Hansen, director, 15 shares of common stock, F. L. Hoyle, director, 10 shares of common stock, G. W. Humphrey, director, 180 shares of common stock, C. W. Lafferty, executive vice president, director, 515,712 shares, 743 shares of common stock, (Lap) is elected to stock but not paid in 1962 under incentive compensation plan, 16,774 shares of common stock, to 6,792 of these shares, Mr. Lafferty has a contingent interest, J. E. Lawrence, director, 290 shares of common stock, R. L. Lamm, director (elected Dec. 21, 1962), 153 shares of common stock, G. H. Love, director, 500 shares of common stock, T. E. McCabe, director, 1,000 shares of common stock, N. B. McElroy, director, 100 shares of common stock, D. A. McGee, director (elected July 27, 1962), 400 shares of common stock, G. G. Montgomery, director, 1,500 shares of common stock, H. S. Nagas, director, 9,038 shares of common stock, G. L. Phillips, president and director, 515,051 shares, 840 shares of common stock, (Lap) is elected to stock but not paid in 1962 under incentive compensation plan, 15,515 shares of common stock, to 4,765 of these shares. Mr. Phillips has a contingent interest and holds another 719 of these shares as executor for his children, G. H. Seaborn, Jr., director (elected Dec. 21, 1962), 100 shares of common stock, R. V. Skerrett, director, 1,000 shares of common stock, W. E. Strickland, director, 100 shares of common stock. Salary figures include, where applicable, salaries, fees, and percentage of incentive compensation earned in 1962 for services performed in 1961 and paid in cash. All stock buy-backs ended, directly or indirectly as of December, 1962. Shares in which persons have a contingent interest refers to shares not owned by them and/or the company's incentive compensation plan. No participant in this plan has the right to vote such shares prior to the time that they are delivered to him.

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The new amplifier (illustration below) is an important advance in deep-sea communications technology.

To make a single amplifier operate in two directions, it was necessary to provide a precise, complex filter system to separate the signals. Signals traveling in one direction occupy a frequency band from 116 to 512 kc., and those traveling in the other direction, from 532 to 3332 kc.

The gain of each amplifier must accurately compensate for its share of cable loss. The total loss rates over the frequency band and, in a transatlantic system, reaches a maximum of 9300 decibels. Since there is no way to adjust an amplifier on the ocean floor, the per-

formance of each one must be pre-established with extreme precision.

A 9600-mile cable link, with its 160 amplifiers, includes 36,000 electronic components. Each component has to be endowed with a reliability far in excess of the requirements of conventional land systems.

The casing and its seal to the cable must prevent minute water seepage at ocean-bottom pressures. This could accumulate fatally over the years, and so production tests employing radioactive isotopes are used to search for any such microscopic leakage.

In bringing the new undersea system to production, Bell Laboratories worked closely with Western Electric, the manufacturing unit of the Bell System. As always, their prime objective was the reliability which comes from rigidly controlled operations—the kind of reliability that the Bell System is known for in the projects it undertakes for the nation's defense.



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These amplifiers are being used in the newest transatlantic cable.

X-12 Engine Series to Follow X-8 Tests

By C. M. Plattner

Canoga Park, Calif.—Next engine in an Air Research Corp. test program at North American Aviation's Rockwell Div. will be designated the X-12 and will involve a high pressure tunnel thrust chamber configuration.

Rockwell has just completed testing of its X-8 engine, the fourth non-flying experimental model developed for USAF's Ballistic System Div. for investigating advanced propulsion concepts. Included in the X-8 program was the study of a liquid hydrogen film cooling technique that Rockwell believes will permit the passage of significant performance increases.

Post & Whitcomb Aircraft, a subsidiary agency, has designed an advanced liquid hydrogen-fueled engine, designated the KL20P-5—that would use inter-combustion cooling, probably with liquid hydrogen, to cool the inner half of the combustion chamber (AW Sept. 25, p. 75).

The new X-12 program, funded by Ballistic System Div. and the Edwards Rocket Propulsion Laboratory for \$400,000, is expected to run about nine months.

Because Ballistic System Div. is contemplating solid and storable propellant engines for future ballistic missiles, the new program was initiated despite the program's tie with liquid hydrogen in the X-8 program. Previous contract in the series, the X-1, X-3 and X-4, used RP fuel and liquid oxygen as storable propellants.

Film cooling with hydrogen, and other is a solid means of cooling in some, probably with evaporative or ablative means, could make possible the design of thrust chambers capable of operating at pressures four to five times current levels, according to Rockwell.

The company feels that sufficient basic research has now been accumulated so that engine test chamber pressures on the order of 1,500 ps. or higher can be designed. Hydrogen has proven a remarkable efficient coolant and both Rockwell and USAF program managers are confident that using a portion of the hydrogen fuel for film cooling will not reduce overall performance gains achieved through the tech improvement.

The cooling technique used by Rockwell is to inject a small percentage of liquid hydrogen inside the thrust chamber from smaller manifolds spaced approximately 4 in. apart axially

along the thrust chamber. The manifolds are shielded from the gas flow by overlapping lips. Both pre-burn and after-burn orifices were used with good results.

The liquid hydrogen flows axially downward along the contour of the solid water wall of the thrust chamber, forming a boundary layer. This prevents the hottest gases of combustion from heating the water part a desired point depending on the amount of hydrogen used.

Temperature measured just upstream of each manifold at the hottest points indicate that one locus zone will temperatures as low as -100°F can be obtained with a relatively small flow of hydrogen.

During thrust chamber pressure

is considered one promising technique for increasing payload capability of future liquid hydrogen-fueled engines. With higher chamber pressures and smaller thrust diameters, size reduction would then be increased, providing more thrust at higher altitudes but level thrust would remain at the same level. This could result in a significant increase in payload capacity but without the benefit of a detailed analysis of a specific engine. Rockwell is reluctant to place an exact value on the potential performance gain.

Film cooling with hydrogen was one of several advanced concepts in liquid hydrogen rocket technology investigated by Rockwell in the experimental engine program, sponsored by Ballistic System Div. The 66,000-lb-thrust



TEST FIRING OF X-8 engine, fourth non-flying experimental model developed by North American Aviation's Rockwell Div., has been completed by the USAF Ballistic System Div.



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1943 — FIRST Bell helicopter flies introducing semirigid rotor and stabilizer bar. **May 1946** — Model 47B receives commercial Helicopter Type Certificate No. 1, FIRST granted by CAA. **December 1946** — FIRST production line Bell helicopter delivered to U. S. Army. **1948** — FIRST skid landing gear introduced. **March 1949** — FIRST helicopter to record altitude of 18,550 feet. **September 1950** — Bell 47D-1 becomes FIRST helicopter to fly over the Alps. **November 1950** — Eight H-13D helicopters, FIRST of new Army order, sent to Korea. **1950-53** — In FIRST combat experience Bell helicopters evacuate over 18,000 casualties during Korean conflict. **September 1952** — FIRST helicopter to record distance of 1,217.31 miles, non-stop: a Bell 47D-1 — from Hurst, Texas to Buffalo, New York. **April 1953** — Bell produces 1,000th H-13/Model 47 series helicopter, a FIRST in helicopter production. **June 1954** — 47D FIRST helicopter to reach 5,000 hours flight time. **December 1954** — Bell's FIRST turbine powered helicopter flies XH-13F with 200 hp Artouste. **February 1955** — Bell wins competition to build HU-1, FIRST production turbine-powered helicopter specifically designed for the Army combat mission. **March 1955** — H-13 FIRST to prove concept of armed helicopter tactics, Fort Rucker. **September 1956** — Army pilots in H-13H set world endurance record — 57 hours 50 minutes, National Air Show, Oklahoma City. **October 1956** — 47J makes FIRST helicopter crossing of the Andes at 17,000 feet. **July 1957** — USAF H-13J is FIRST helicopter to fly President of the United States. **August 1958** — FIRST turbine powered production helicopter delivered to Army. **December 1958** — Bell XV-3 convertiplane makes aviation history with FIRST full conversion of tilting prop-rotor VTOL aircraft. **December 1959** — A 47D-1 becomes world's FIRST helicopter to log 10,000 flight hours. **July 1960** — Army pilots in HU-1 capture six world and one U. S. performance records. **February 1961** — Bell Model 47 sets eight new world performance records. **June 1961** — Navy HTL-6 sets new world endurance record, remaining airborne 72 hours 2 minutes at Ellyson Field, Pensacola. **1962** — UH-1 is FIRST Army armed helicopter to see combat duty. **April 1962** — YUH-1D establishes three world performance records in speed and rate of climb. **December 1962** — First flight of Bell LOH; FIRST LOH to fly. **February 1963** — Three UH-1Bs are FIRST helicopters to land at the South Pole. **May 1963** — First production UH-1D delivered. FIRST Army helicopter organic to division level to have armament and tactical troop transport capability.



BELL HELICOPTER COMPANY

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Production of Omega BS-12-D3S Awaits Court Merger Approval

Acquisition of Omega Aircraft Corp. of New Bedford, Mass., into Aero Industries, Inc. of Bensenville, Ill., is a wholly owned subsidiary, which would clear the way for production of Omega's BS-12-D3S helicopter, awarded final approval of a Russian Federal Grant last week.

Aero Industries, which presently operates the Franklin Engine Co., Inc. at Syracuse, N.Y., Waco Aircraft Co. at Troy, Ohio, Jacobs Aircraft Engine Div. of Portstown, Pa., and three other subsidiaries, would assume the debt of Omega, which entered into voluntary bankruptcy proceedings under Chapter 11 of the Federal Bankruptcy Act in July, 1962.

If the plan is approved, Aero Industries probably would manufacture the

BS-12-D3S at the Syracuse factory of Franklin Engine. The two-engine, single-rotor flying crane, which is designed for use with a detachable four-lift pod, currently is certified with Lycoming engines.

As part of the reorganization plan submitted by Aero Industries, however, the helicopter currently is being certified with 360-hp. TV-360A engines.

It is understood that dynamic components of the helicopter would be manufactured at Aero Industries' Portstown facilities, the engine and sheet metal parts at the Waco factory in Troy, with final assembly and certification of the machine to be done at a facility adjacent to Franklin's Syracuse factory.

Under terms of the proposed reorganization agreement, Aero Industries

would acquire Omega for \$10,000 in cash and a loan of approximately \$232,000, plus up to 25,000 shares of Aero Industries stock.

This would enable Omega to begin payment of various debts, including loans of \$100,750 from the Governor New Bedford Industrial Foundation and \$6,826.24 from the First State Deposit National Bank of New Bedford, plus bank loans, other obligations to federal, state and local governments and claims for services, supplies and merchandise to various parties.

Present capital stock of Omega, totaling 357,565 shares, would be retired and eliminated from the structure of the corporation.

The New Bedford Industrial Foundation, which loaned Omega \$90,000 during 1958 and 1959 as a means of providing new industry for the area, would have an option of receiving a \$30,000 quality air seal helicopter sold on this total loan plus \$14,750 accrued interest was paid or accepting promissory notes for \$50,000 to be paid in 60 equal installments. Aero Industries would guarantee the promissory notes.

General reorganization of Omega would be paid in stock of Aero Industries and Aero Industries will guarantee the payments by Omega in the amount allowed by the court.

Construction of the Omega BS-12-D3S helicopter with Franklin engines is estimated to be about two months from completion. A detachable night-vision flight pod, which also can carry four litter and a medical attendant, is being developed as well.

When the original Omega was certified several years ago, a number of orders were reported received, but the aircraft never went into production because of a lack of capital.

Work on production testing for the helicopter currently is under way.

PRIVATE LINES

Dallas American, Inc. has reported completion of \$4,707,040 for the six-month period ending Aug. 31, but not income was down slightly from a corresponding period in 1962. Net income in 1963 was \$218,648, or 40 cents per share, compared with \$187,239, or 47 cents per share, for the same period last year.

Ruston Aircraft Corp., first flown in 1963, has completed technical and flight tests and will soon enter mass production. The company's Ruston-Peels has reported that the aircraft is single-seat, all-metal and will be used as a trainer.

Piper Aircraft Corp. reported it delivered 147 twin-engine aircraft during August and September, which is believed

From Moon Bounce to ASW

SOME TECHNICAL HIGHLIGHTS OF A DIVERSIFIED YEAR OF RESEARCH

As an independent, non-profit research organization, Cornell Aeronautical Laboratory has, in the past fiscal year, completed or appreciably advanced the maturity of over 300 different projects in widely varying areas of technology. These efforts included some \$18 million in contracted research.

As reported in the recent "1963 Report on Research" here are but a few of our programs:

Maneuver radar echoes using the Laboratory's High Power (50 megawatt peak) radar were examined for clues to the characteristics and shape of the target surface. The High Power system also was employed to yield significant new information in studies of radar backscatter from the ionosphere.

An investigation in stellar guidance systems was undertaken to determine the probability of stellar ray distortions associated with the hypersonic flowfield environment and related experiments in the 40" hypersonic shock tunnel.

In between-flying research, an intensive flight program was successfully completed with a series of fully automatic, low-altitude flights utilizing the CARL developed AUTOTEST system in a jet aircraft.

Program was made in antenna designs for aerospace vehicles, during which to assure antenna survival, subatomic coupling to the plasma medium and minimum deformation of the antenna pattern in a similar area, short duration hypersonic testing techniques were applied to microwave radar phase investigating.

In hypersonics, our research included investigation of gas equilibrium, ionization in electric flows using interferometer to study electron recombination rates, experimental studies of ionization in electric flow heating for return and orbital stages, initial determination of a new shock tube designed to produce 40,000 ft/sec at altitudes of 250,000 feet, and first operational testing in the Ames 5-foot-7-inch low density hypersonic tunnel with capabilities up to Mach 15 and 8500°K for periods up to 18 seconds.



CORNELL AERONAUTICAL LABORATORY, INC. at CORNELL UNIVERSITY



Mooney Offers Three Models for 1964

Mooney Aircraft Mark 23, equipped with a 200-hp. engine has been added to the Mooney Aircraft line for 1964, giving the company three models, including the 180-hp Mark 18, retooled, and the Mark 20D Master, a four-seat version of the Mark 21. New Super 21 has a maximum speed of 197 mph at 97% power and 2,700 mph at 2,500 ft when loaded to 2,800-lb gross weight. It will cruise at 168 mph at 20,000 ft using 5100 of power. The Mark 21 has a top speed of 183 mph and cruises at 159 mph. The Master has a top speed of 187 mph and a cruise speed of 157 mph. Mooney is planning to increase production 20% in 1964 over the 1963 aircraft produced for 1963.

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to be a new industry record. Included were 34 Aéro B, 11 Apache 250, and 151 Twin Canarders. Previous Piper high delivery week was in May and June, 1960, when 160 twin engine aircraft were delivered.

Russia's Aeroflot is considering development of a high-density version of its two-engine An-14 "Pridol" (Little Bear) short-haul transport. Current version of the aircraft seats 100 passengers, and the high-density aircraft would seat 9 to 11.

Dallas Aerospace has received a one-year contract to overhaul USAF Pratt & Whitney R-4380 reciprocating engines. The firm estimates the value of the contract at \$1 million.

Booth Aircraft Corp. total sales went up approximately 8% in Fiscal 1963, which ended Sept. 30. Sales exceeded \$73 million, compared with total sales of \$67,641,507 for Fiscal 1962. Commercial sales increased more than 12%; less than \$40,113,105 to more than \$45 million, and military and spare sales increased \$20 million, compared with \$17,113,692 in Fiscal 1962.

Federal Aviation Agency has listed new tolerances allowable for aircraft entering or operating in Air Defense Identification Zones (ADIZs) or Distinctive Early Warning Identification Zones (DEWIZs). Time allowance is 5 min. less estimated time when entering an identification zone or passing over a reporting point and 5 min. less proposed time of departure if the flight originates within a zone. The latter may be extended by reporting to an aerodrome facility. Distance tolerances are 10 nmi. or less from the coastline of the state of flight when entering an operating within a DEWIZ or 10 nmi. or less at the end of a coastal ADIZ or a DEWIZ. The FAA cautions that aircraft failing to meet these tolerances may be intercepted for identification.

Four of three Cessna 441 aircraft have been delivered to the Costa Rican Civil Guard by the United States under the Military Assistance Plan. The aircraft, designated U-17A by USAF, will be used for border and jungle patrol work.

First U.S. civil aircraft registry now is available from the Federal Aviation Agency. The publication, which will be updated semi-annually, lists more than 100,000 aircraft with aircraft's registration number, name, address, and other information needed on removal during the past five years. The registry is available from the U.S. Government Printing Office, Washington, D.C., 20402, at \$5.15 per copy.



Open House for Creative Minds

Complexity of RAC's new research center holds important meaning for the organization itself and for the experienced scientist or engineer seeking a house for his ideas and room to grow personally and professionally.

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high rate of defense and space spending—through governmental agencies will give even closer scrutiny to all objectives and programs.

Governmental purchases of the things our industry sells—airplanes, missiles, space rockets, electronic rocket fuels, instruments, ships, and related services—already control \$12 billion a year. The defense appropriations bill passed by Congress and the space bill now before Congress and under the torch regulated by the President. But they provide funds to continue this size of expenditures.

To be needed proofs of appropriations bills does not present a level of procurement. Since individual programs can be modified, cancelled, cut or modified. Yet steel, automobiles, and other industries have their high and low periods and periods for individual items or models.

We are aware that the political volume of government contracts purchases does not guarantee a market for Lockheed or North American. Chairman, or any other individual or company or individual project. We look for some strong competition among companies looking to maintain and expand their market. Aerospace companies can expect deep cuts in their work in the past but in the long term we expect a continuing industrial government market for which we can compete.

There are still changes in the direction of the industry. Our industry is trying to reevaluate the best means of maintaining and strengthening our capacity to meet the continuing Communist threat. Should we do more in progress for limited work? Should we step up our development of our military and aerospace interests? And what about the military requirement in space? How urgent is the moon program?

And what if this new military and space projects of industrial projects such as the aerospace transport and communications aircraft?

These questions are difficult, and it is not easy to forecast the future. Those of us who are serious in the industry recognize how many people predicted the total collapse of aircraft industry after World War 2. Yet in 1945 the industry built more than 1,000 military airplanes, and its sales in 1947 were less than that of 1939.

We remember predictions of aerial in-depth delivery in the late 1940s—and the B-52s still stand the test for modern transport and combat planes.

We remember forecasts of a decline in our industry after the war in Korea. Yet our industry's sales the following year were less than the pre-war level.

We remember those who predicted the phasing out of military airplanes in the mid 1950s as large-scale missiles became perfected. The fact is that spending for aircraft did not diminish in 1955, but it has remained at the high level of \$7 billion a year since 1951. And we remember those who expected expenditures in space—until the first Sputnik and then Russian advance in sub-orbital space.

I mention these historical facts because there is a danger to some of the predictions we have heard in recent weeks. These predictions are based upon a superficial view of the industry, like one given in response of national opinion. Such statements can actually damage the industrial base on which the United States relies for its national defense.

Every time our industry has passed through one of these periods of a temporary lull in need for our products, we have continued steadily in attracting college



Here, at Lockheed Missiles & Space Company's Space Communications Laboratory, scientists are re-inventing the possibility of using the moon to facilitate earth communications. Possibilities for the use of the moon as a relay station for earth-to-earth communications have been largely neglected because the moon's shape and rugged surface greatly distorted a return signal. But Lockheed research into the extension of communications on difficult communication channels, using techniques applicable to degrading this variant channels, is making significant heads into this problem.

Another area receiving intense study at Lockheed is satellite tracking at deep space probes—since tracking accuracy depends greatly on stations being as far from each other as possible, while retaining line-of-sight communications. Lockheed is studying the use of two earth-orbiting satellite tracking stations, 6,000 miles apart. Not only would great accuracy be gained by a separation, but it would be further enhanced by the positioning of the stations above the earth's atmosphere, thus eliminating atmospheric distortion.

Examples of other research projects being pursued by Lockheed in the communications area include: Random motion tracking, satellite rescue techniques, satellite communications, radar mapping, submarine tracking, modulation of optical energy, communications over multiple channels, and learning systems.



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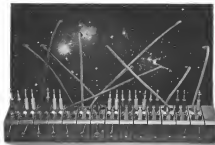
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XC-142A Nose and Mid-Section Mated

Nose section and mid-section of the first XC-142A VSTOL cargo transport were mated recently at the Ling-Temco-Vought plant in Dallas. Two sections were assembled separately and moved to the mating jig where they will undergo additional modifications. The XC-142A is scheduled to make its first flight in Dallas next summer. Note framework for access door, in center of the fuselage.



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As I have said, the answer is in our work on this task force can only be success. One is not the responsibility of government here, more, also, because as a citizen or member are needed to ensure the protection of our nation. Neither is it our responsibility to tell government how, but for it should be in its own position that we do have a responsibility, we think, to make clear the dangers of inadequate government, long term which in developing and gathering complex defense critical and danger of not keeping up with advanced technology.

Gradual Reduction Proposed

The U. S. is prepared to the 17-year investment condenser in Canada but not below 15 years.

The last year agreement has accomplished only a part of its goal.

Columbia University Professor Thiele Paul, consultant to the U. S. Arms Control and Disarmament Agency, has published a long series of recommendations in his book, "Disarmament and the Arms Race."

He proposed a gradual reduction in arms spend over 12 years. This would still leave spending for defense and space activities at more than \$16 billion a year in 1977. So far as we can determine, plans in Washington are talking of relatively small increases in the remainder of the decade you would think a continued from reading past events.

I do not agree with the financial writer who said "the airplane and missile business is dying on the vine these days." And I do not agree with those who have said there are no new major defense programs coming along.

New Opportunities

The fact is that more in the history of any company has not been offered in many opportunities in purpose and led us new projects in the fields of aircraft, missiles, space and related areas. And I don't mean just small study contracts, but projects of great magnitude—many with dollar points with running into hundreds of millions.

Now where do we stand in our efforts to diversify?

Certainly our diversification goals would embrace the non-defense part of our business through internal product development and acquisition. We have made considerable progress in this field, most of them relatively small but many with potential for the future.

I would, of course, be less than frank if I did not admit that we have difficulties in judging these activities and understanding them. Aerospace companies have become so specialized that diversification into other areas is hard. One emphasis on science and

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Air Taxi Service

The primary purpose and intent of our novel or unclassified as true survey is to replicate the stratified census survey by finding into and out of identified points. Some identified and are unknown aspects have tested the identified as true replication into a freehold authority to provide anything up to transcontinental wheel and axle.

It is a myopic opinion that the mass population of unskilled job seekers over the course of stratified societies, especially in the United States, will be able to find time with their own economic needs and should be further restricted. Some thought should be given to the according of financial resources to the unemployed in order to apply for an occupation outside of peasant subsistence or to create some specific route. This would provide some control of peasant mobility and would be a step toward ending every Tom, Dick or Harry who can afford a little accident from inheriting his own means of subsistence. The unemployed must be freed from economic dependence on the state in direct competition, and thus to put the oppressed masses into a position to be able to move out of their own economic situation and to generate self-sufficient traffic to justify civilized land service and even more with no service at all. The unemployed must be able to find service points (not just the government) for a standard and profitable mass, subsistence land service or keeping with current needs.

If some of these overbuilders or too operators don't stop thinking so big, they are going to find there is a lot of money in this bedded or too business, because they are going to put it there.

John C. Van Antwerp
President
Freemasons Boston Lodge, No.
Freemasons, Mass.

TFX Conflict

While Mr. Fieppel's statement (AW Oct. 23, p. 112) will probably do little to regulate the already well-behaved TFX industry, it might create some interesting lawsuits in other areas.

I imagine there are many readers who would be curious to see Mr. Proger's figures and sources of information on the relative performance of the B-57 with the YB-60 and the B-47 with the B-52. The only way I see I have any say is the B-52 is doubled over the YB-60 in both speed and altitude due to the YB-60's lower power/weight ratio. In this respect it would be astounding to note that the B-52 was largely an outgrowth of the C-54/D-47, while the YB-60 stemmed from the addition of jet engines, swept wings and tail to the lineage of a B-24D, a piston-engined bomber with a top speed of only 337 mph with all 10 engines in full throttle.

designed for a close support role that is not being filled by the English Electric Nimble E-17 and the Boeing E-47? A strategic medium bomber like the E-47 had more than a 10 mph speed advantage over the E-51, could carry 3,000 lb more in maximum bomb load than the E-51 and to maintain other advantages in both range and altitude. But since these bombers were designed for different roles the reason for their common choice was:

It would seem that we got our money's worth in performance even back in the 1970s. The same classes of the B-72 over the YB-80, the B-47 over the Martin B-48 (rather than the B-70) would surely still be made had cost-effectiveness been in use at the time.

THEODORE L. GELLNER, JR.
New York City, N. Y.

ALPA vs. CAB

Your article (JAW Oct. 21, p. 52) concerning the Eastern Air Lines DC 7 accident at Midvale last November fails to adequately point out the real significance of the difference in opinion between the CAB and NTSB as to its cause.

The CNA's conclusions promise that the crew did not suffer approved procedures and that, if it had, the accident could not have occurred. It does not point out that everything is viewed through a lens of a 17 out of 17 out of a risk rate of 600 per annum, the pilot would have had only 24 sec in which to evaluate an unexpected situation, make his decision, complete the transition from visual to instrument reference, and maneuver the airplane into a positive climb configuration. A USMC Medical Safety Div study conducted a few years back pointed the following facts regarding human error: errors in the air.

Time from eye image to brow	0.1 sec
Recognition time of brow	1.6 sec
Decision time	5.6 sec

Deposure time to movie	0.4 sec
Movie duration time	0.4 sec
Air cushion time	5.0 sec

Total fracture time 119 sec
Obviously a successful pullout under these
circumstances, apparent procedures not
waterproofing would have been virtually im-
possible.

In addition to effectively misquoting a fine proven professional pilot and recognized safety authority, the tragedy of the *Alouette's* crashing at that it failed to cause to point out the obvious and cardinal rule of helicopter flight safety: *Don't fly into the terrain!* The FAA also fails to acknowledge the rudiments of the "cultural common" and "monoculture" that are inherent in this business and brain where there is no escape to reality how someone like the perpetrator, who knew skilled the pilot, the writer, it does not communicate, the fact that the pilot was not a professional pilot and ability to avoid their traps or in other words the information he received in this case, he was just plain misled as to the conditions that actually existed at the most critical stage of his approach. This incident, which is a tragedy, is a tragedy because of being such a tragedy, to the fact that while the pilots and planes may be useful, the

tural climate for safety surrounding loss, especially, when there is little or no tolerance for error, as for health systems.

In order to ensure that the 2000 election, its parameters, and issues have not been set in stone, it would seem prudent to, at least prior to the present heading into the fray of all-wireball flight operations and the associated margins of safety afforded by present operating limits and procedures. Perhaps, the role of technology, including, digital, analog, and hybrid systems, and the use of various sensors, ground and airborne components, distributed lighting, instrumented locations, guidance systems, sensors, display units, etc., is critical to navigation and route follow-up to maintain a few feet below terrain which can be the difference between a safe operation and an accident, need to be objectively reviewed.

Lastly, the CAG could much better serve the cause of air safety with justice by properly identifying those real constructive lessons to be taken from accidents and reporting them in that true perspective rather than automatically reconstructing the same old crude story upon which to nail the pilot, after that one already dead.

Electronic Capacitors

You desire compliments for your article. Congratulations to Stephen A. Krasnowski, just the best of us (see p. 56). It might be quite worthwhile for you to research and publish a similar article on electronic paper-to-paperless transition types. While the semiconductor market overall is much larger, electronic capacitor manufacturers are undergoing the same type of problems, particularly in the solid electrolytic polymer electrolyte types. Also, manufacturers are detecting the growth of discrete capacitors in the electronic capacitor market, but there has been very little published concerning this field.

Your reporting is informative and short. We look forward to such news.

G. W. Frost
Manager Marketing
Electronic Specialty
Capacitor Product Section
General Electric Co.
Iss., S.C.

Concorde Delivery

Just for the record, in view of statements in *Aerospace Week* on Sept. 30 and Oct. 14—the Conquest delivery program has not "gone back to 1973. The timetable to meet is originally announced, i.e.—prototypes in 1966 and early 1967, two per production aircraft in 1968 and delivery in 1970.

I think *Anytime With Me* and through *Anytime With Me*, Burt, achieved the two 1960 per-production success with the production delivery success of 1970.

CHARLES GARDNER
Publicity Manager
British Artists Corp., Ltd
Weybridge Surrey
U.K.



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